NOVEMBER 2014

Salt and Nutrient Management Plan

Santa Clara Subbasin

Santa Clara Valley Water District

REVISED FINAL
SALT AND NUTRIENT MANAGEMENT PLAN: SANTA CLARA SUBBASIN

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TABLE OF CONTENTS

Page

TABLE OF CONTENTS

Page

TABLE OF CONTENTS

Page

TABLE OF CONTENTS

Page

TABLES

TABLE OF CONTENTS

Page

TABLE OF CONTENTS

Page

TABLE OF CONTENTS

Page

FIGURES

TABLE OF CONTENTS

Page

TABLE OF CONTENTS

Page

ACRONYMS

LIST OF ACRONYMS USED

ABAG	Association of Bay Area Governments
AF	Acre-feet
AF/yr	Acre-feet per year (about 326,000 gallons)
AGR	agricultural water supply
AWWA	American Water Works Association
BAWSCA	Bay Area Water Supply and Conservation Agency
BDCP	Bay-Delta Conservation Plan
BMO	basin management objectives (defined in the Groundwater Management Plan)
CASTNET	Clean Air Status and Trends Network
CEQA	California Environmental Quality Act
CDPH	California Department of Public Health
CECs	Constituents of Emerging Concern
CMAQ	Congestion Mitigation and Air Quality Improvement model
CVMOD	Coyote Valley Groundwater Flow Model
CVP	Central Valley Project
DDW	Division of Drinking Water (part of SWRCB, formerly part of CDPH)
DPR	direct potable reuse
DSOD	Division of Safety of Dams
DWR	Department of Water Resources
DWSAP	Drinking Water Source Assessment Program
EBMUD	East Bay Municipal Utility District
GIS	Geographic Information System
gpad	gallons per acre per day
gpimd	gallons per inch diameter per mile of sewer per day
GWI	groundwater infiltration
GWMP	Groundwater Management Plan
ha	hectare
INAAP	Infield Nutrient Assessment Assistance Program
IND	Industrial water supply
IPR	Indirect Potable Reuse (of recycled water)
IRWMP	Integrated Regional Water Management Plan
LAMS	LAMS = Large Area Mosaicing Software
LID	Low Impact Development
MCL	Maximum Contaminant Level
M&I	municipal and Industrial (pumping)
MFR	Mountain Front Recharge
MLE	Maximum Likelihood Estimate (a statistical method)
MGD	million gallons per day
MODFLOW	the USGS's three-dimensional, modular, finite-difference groundwater flow model used for simulating and predicting groundwater conditions and groundwater/surface-water interactions.
MRLC	Multi-Resolution Land Characteristics Consortium
MRP	Municipal Regional Permit (for Stormwater/NPDES)
MUN	Municipal and domestic water supply

NAPD	National Atmospheric Data Program
NO_3	nitrate as nitrate
NPDES	National Pollution Discharge Elimination System
OM	Outcome Measures in the Groundwater Management Plan
OWTS	On-site Wastewater Treatment System
OWTSO	Onsite Wastewater Treatment System Ordinance
PARWQCP	Palo Alto Regional Water Quality Control Plant
PCA	Potentially Contaminating Activities
PCBs	polychlorinated biphenyls (a class of toxic and bioaccumulative chemicals used as dielectric coolant in transformers)
PROC	industrial process supply
RWQCB	Regional Water Quality Control Board
ROWD	Report of Waste Discharge
RW	Recycled Water
SBWR	South Bay Water Recycling
SCADA	Supervisory Control and Data Acquisition (computer system for gathering and analyzing real time data)
SDWA	Safe Water Drinking Act
SCPMOD	Santa Clara Plain Groundwater Flow Model
SCVURPPP	Santa Clara Valley Urban Runoff Pollution Prevention Program
SJ-SC RWF	San José-Santa Clara Regional Wastewater Facility
SFPUC	San Francisco Public Utilities Commission
SJWC	San Jose Water Company
SMCL	Secondary Maximum Contaminant Level
S/N	salt and nutrient
SNMP	Salt and Nutrient Management Plan
SRWS	Self Regenerating Water Softener
SSO	Sanitary System Operator
SVAWPC	Silicon Valley Advanced Water Purification Center
SVWPCP	Sunnyvale Water Pollution Control Plant
SWID	Stormwater Infiltration Device
SWP	State Water Project
SWRCB	State Water Resources Control Board
TDS	Total Dissolved Solids
TMDL	Total Maximum Daily Loads
TPY	Tons Per Year
USGS	United States Geological Survey
UWMP	Urban Water Management Plan
VCP	Vitrified Clay Pipe
VWA	Volume-weighted average
WDRs	Waste Discharge Requirements
WSIMP	Water Supply Infrastructure Master Plan

EXECUTIVE SUMMARY

In February 2009, the State Water Resources Control Board (SWRCB) adopted the statewide Recycled Water Policy that encourages increased use of recycled water and local stormwater, together with enhanced water conservation. The Recycled Water Policy calls for basin-wide management of salts and nutrients from all sources with the goal of attaining water quality objectives (WQOs) and protecting beneficial uses of groundwater.

Because recycled water can contribute salts and nutrients to groundwater, the Recycled Water Policy requires local entities to develop a Salt and Nutrient Management Plan (SNMP) to support streamlined permitting of new recycled water projects while managing salts and nutrients basin-wide.

This SNMP for the Santa Clara Groundwater Subbasin was prepared by the Santa Clara Valley Water District (District) with input from stakeholders, including the San Francisco Bay Regional Water Quality Control Board, Santa Clara County, water retailers and recycled water producers, the farm bureau, and interested stakeholders such as environmental groups.

The purpose of this SNMP is to comply with the SRWCB Recycled Water Policy by:

- Evaluating all sources of salt and nutrient loading to the Santa Clara Subbasin,
- Determining whether current and projected salt and nutrient concentrations are consistent with applicable WQOs
- Developing recycled water and stormwater goals and objectives,
- Providing a plan for long-term groundwater monitoring, and
- Identifying sustainable measures to manage salt and nutrient loading to groundwater.

An overview of the SNMP, including key findings, is provided below.

Study Area

The Study Area for this SNMP is the Santa Clara Groundwater Subbasin[1] in northern Santa Clara County, including the Santa Clara Plain and Coyote Valley. Groundwater typically provides about 45 percent of the water used in the Santa Clara Plain. Treated water provides the majority of the water used, with minor portions served by local surface water and recycled water. Tertiary-treated recycled water is used for irrigation and industrial purposes in Palo Alto, Mountain View, Sunnyvale, Santa Clara, San Jose, and Milpitas. Advanced-treated recycled water from the Silicon Valley Advanced Water Purification Center is now blended into recycled water serving San Jose and Santa Clara. The Coyote Valley relies almost entirely on groundwater, with small amounts of surface water used.

Water supply management of the Santa Clara Subbasin includes active groundwater replenishment operations conducted by the District. Significant volumes of imported water and surface water released from local reservoirs, along with local runoff are recharged in ponds and in-stream facilities. On average, the District's Managed aquifer recharge (MAR) represents two-

[1] The Santa Clara Subbasin is part of the Department of Water Resources-defined Santa Clara Valley Groundwater Basin.

thirds of the annual groundwater pumping in the Santa Clara Plain and 120% of pumping in the Coyote Valley.

Existing Groundwater Quality

Groundwater quality within the Santa Clara Subbasin is very good and is acceptable for all beneficial uses designated in the Basin Plan. Total dissolved solids (TDS) and nitrate (as NO_3) are used as representative salt and nutrient indicators for this SNMP. The volume-weighted average for the Santa Clara Subbasin is 425 mg/L.

Average TDS and nitrate concentrations were compared with the recommended secondary drinking water standard of 500 milligrams per liter (mg/L) and the primary drinking water standard of 45 mg/L, respectively. Average TDS and nitrate concentrations in all areas are well below their respective WQOs. Accordingly, there is available assimilative capacity. Trend analyses indicate nearly all wells analyzed show stable or decreasing trends for TDS and nitrate.

Salt and Nutrient Sources

Major current sources of TDS loading to the Santa Clara Plain include landscape irrigation and managed aquifer recharge, and in Coyote Valley, managed aquifer recharge and agricultural irrigation. Minor sources of TDS loading include recycled water, drainage and conveyance losses (leaks in storm drain, sewer, and water transmission pipes). The primary sources of nitrate in the Santa Clara Plain are landscape irrigation with potable and recycled water, and groundwater flowing into the Santa Clara Plain from Coyote Valley. In the Coyote Valley, agricultural fertilizer and irrigation, and septic systems are the primary sources of nitrate.

All sources of groundwater recharge add salt and nutrient load to the subbasin. Recharge sources with lower TDS and nitrate than ambient groundwater will result in improved groundwater quality. Average concentrations of TDS and nitrate in all sources of groundwater recharge combined are much lower than average groundwater concentrations.

Salts and nutrients are removed from the subbasin through groundwater pumping, basin outflow, gaining reaches of streams, and groundwater infiltration into storm drains and sewer mains. The difference between total salt and nutrient loading and removal determines whether there is currently net loading or net removal, as summarized in Table 1.

Table 1 – Net Loading of Salts and Nutrients in the Santa Clara Subbasin

	Santa Clara Plain		Coyote Valley		Santa Clara Subbasin	
	TDS	**Nitrate**	**TDS**	**Nitrate**	**TDS**	**Nitrate**
Total Loading, tons per year	89,600	1,130	7,850	226	97,450	1,356
Total Removal, tons per year	58,080	890	10,860	670	68,940	1,560
Net Loading, tons per year	**31,520**	**240**	**- 3,010**	**- 444**	**28,510**	**- 204**

Future Salt and Nutrient Loading and Assimilative Capacity

Loading and removal categories were quantified to support a salt and nutrient mass balance. Fate and transport of salt and nutrients was estimated, and nitrate attenuation factors were developed. A ten-year baseline mass balance was developed for 2001-2010 to establish median loading rates by category. Forecasts were developed for future loading and removal, accounting for improvements to recycled water quality through advanced treatment, planned indirect potable reuse projects, water supply demand projections, and other factors. These forecasts were used to project future TDS and nitrate concentrations, compare those concentrations to applicable WQOs, and evaluate available assimilative capacity. For the SNMP planning horizon ending in 2035, TDS concentrations are projected to decrease in Coyote Valley and increase the Santa Clara Plain. Nitrate is projected to decrease in both the Coyote Valley and Santa Clara Plain. Under the future salt and loading forecast in this SNMP, it is projected that there will be available assimilative capacity for both TDS and nitrate as shown in Table 2, below.

Table 2 – Projected Salt and Nutrient Concentrations and Assimilative Capacity

Sub-Area/Aquifer	Volume Weighted Average TDS, mg/L	TDS Assimilative Capacity	Volume Weighted Average Nitrate as NO_3	NO_3 Assimilative Capacity
Basin Plan Objective	***500***		***45***	
Santa Clara Plain – Shallow	528	**-28**	9.1	**35.9**
Santa Clara Plain – Principal	410	**90**	11.0	**34.0**
Santa Clara Subbasin	425	**75**	10.7	**34.3**
Coyote Valley	377	**123**	20.0	**25.0**

Assimilative capacity is the difference between the Basin Plan Objective and the average groundwater concentration.

Anti-Degradation Analysis

The SNMP analysis finds that current and planned recycled water use by 2035 causes only minor water quality changes to the subbasin with respect to salts and nutrients. Accordingly, recycled water project(s) are consistent with the maximum benefit of the people of the State and can be increased while still protecting groundwater quality for beneficial uses.

Salt and Nutrient Groundwater Quality Management Programs

Projects and programs to manage salt and nutrient loading on a sustainable basis have been implemented by the District and subbasin stakeholders for many years. The SWRCB Recycled Water Policy states that within one year of the receipt of a proposed SNMP, the RWQCBs shall consider for adoption revised Basin Plans for groundwater basins where WQOs for salts and nutrients are being, or are threatening to be exceeded. Accordingly, the need for implementation measures to limit and reduce salt and nitrate concentrations is determined by comparing current average and simulated future groundwater quality with WQOs.

Current and projected TDS and nitrate concentrations in the Santa Clara Subbasin do not exceed WQOs, so implementation measures are not required. Nonetheless, many groundwater quality management initiatives have been conducted in the Santa Clara Subbasin by the District and SNMP stakeholders, and may continue as deemed appropriate by their proponents. A summary of groundwater quality management initiatives is provided in Appendix 4.

SNMP Monitoring Program

For many years the District has conducted regular and comprehensive monitoring that includes TDS and nitrate, as well as other water quality parameters. The District also analyzes data from public water supply wells. The proposed SNMP Monitoring Program is the District's voluntary subbasin monitoring and reporting for TDS and nitrate. The District prepares an annual groundwater report that documents monitoring results, provides trend analyses for TDS and nitrate, and compares detections with WQOs. District reports are available on the District website.

CHAPTER 1: INTRODUCTION AND BACKGROUND

This chapter provides an overview of the Salt and Nutrient Management Plan (SNMP) for the Santa Clara Groundwater Subbasin, including related state and local policy. This chapter also summarizes the stakeholder process related to the Santa Clara Groundwater Subbasin SNMP.

1.1 Introduction

This SNMP was developed through a stakeholder process led by the Santa Clara Valley Water District (District), the manager of the Santa Clara groundwater Subbasin. The District was formed by the Santa Clara Valley Water District Act (District Act)[2] for the primary purpose of providing comprehensive management for all beneficial water uses and protection from flooding within Santa Clara County. Per Sections 4 and 5 of the District Act, the District's objectives and authority related to groundwater management are to recharge groundwater basins, conserve water, manage and store water for beneficial and useful purposes, increase water supply, protect surface and groundwater from contamination, prevent waste or diminution of the District's water supply, and do any and every lawful act necessary to ensure sufficient water is available for present and future beneficial uses.

Sources of water for Santa Clara County include local reservoirs, groundwater, imported surface water from the State and Federal Water Projects (including water banking in Kern County), San Francisco Public Utilities Commission supplies, and recycled water. In addition, the District operates a highly successful water conservation program. As much as half the water used in the county is pumped from the ground with the proportion of water supplied by groundwater varying by city and by different water companies. Consequently, groundwater protection from salt and nitrate accumulation is critical to ensure long-term water supply reliability in Santa Clara County.

Recycled water is a small but important and growing source of water in Santa Clara County. It is currently used for non-potable uses including irrigation, industrial applications (e.g., cooling), and agriculture. Using recycled water helps conserve drinking water supplies, provides a drought-proof, locally controlled water supply, and reduces dependency on imported water and groundwater. The District has established partnerships with the four recycled water producers in the county to expand recycled water use. Future recycled water plans include use of advanced treated recycled water for indirect potable reuse and possibly direct potable reuse.

The State Water Resources Control Board (SWRCB) recognizes the importance of recycled water as a key element in local water supply portfolios and adopted the 2009 Recycled Water Policy to guide the preparation of SNMPs to support expanding recycled water uses. The purpose of this Santa Clara SNMP is to evaluate all sources of salts and nutrients (S/Ns) loading to groundwater in the Santa Clara Groundwater Subbasin, develop recycled water and stormwater goals and objectives, provide a plan for long term groundwater monitoring for S/Ns, and identify measures to manage S/N loading to groundwater on a sustainable basis.

1.2 State Water Resources Control Board 2009 Recycled Water Policy

SWRCB Resolution, 2009-0011 adopted a policy for water quality control for recycled water (Recycled Water Policy). The Recycled Water Policy encourages increased use of recycled

[2] Santa Clara Valley Water District Act, Water Code Appendix, Chapter 60.

water and local stormwater to enhance drought-proof, reliable, and sustainable water supplies over the long-term. The intent of the Policy is to ensure that every groundwater basin/subbasin in California has a consistent SNMP. The SWRCB found that the appropriate way to address S/N issues is through the development of regional or sub-regional S/N management plans rather than through imposing requirements solely on individual recycled water projects. A full copy of the Recycled Water Policy is provided in Appendix 1.

The key provisions of the Recycled Water Policy related to S/N planning are:

- SNMPs will be developed for each groundwater basin/subbasin in California by local water and wastewater entities, together with local S/N contributing stakeholders, through a locally driven and controlled collaborative processes open to all stakeholders and with participation by the RWQCB staff;

- The salt and nutrient management planning process should comply with the California Environmental Quality Act (CEQA);

- The SWRCB intends that stormwater use and recharge become a component within the SNMPs because this water is typically lower in nutrients and salts and can augment local water supplies, providing a long-term sustainable use of water in California;

- SNMPs must address and implement provisions, as appropriate, for all sources of salts and nutrients to groundwater basins, including recycled water irrigation projects and groundwater recharge reuse projects; and

- The policy requires that SNMPs be completed and proposed to the RWQCB by 2014. However, if the stakeholders can demonstrate substantial progress towards completion, a two-year extension may be granted.

The Recycled Water Policy also specifies that each SNMP include the following components:

- A subbasin wide monitoring plan that includes an appropriate network of monitoring locations;

- A provision for annual monitoring of Constituents of Emerging Concern (CECs), such as endocrine disruptors, personal care products, pharmaceuticals consistent with recommendations by the California Department of Public Health and any SWRCB action;

- Water recycling and stormwater recharge/use goals;

- S/N source identification, subbasin assimilative capacity, and loading estimates;

- Implementation measures to manage S/N loading in the subbasin on a sustainable basis; and

- An anti-degradation analysis demonstrating that the projects included within the plan will collectively satisfy the requirements of SWRCB Resolution No. 68-16.

1.3 Stakeholder Participation

The District, as the groundwater management agency for the county, led the salt and nutrient management planning effort in collaboration with local water and wastewater entities, contributors of salts and nutrients, and stakeholders. Table 3 lists SNMP stakeholders, stakeholder meeting dates, and topics addressed.

Table 3 – Santa Clara Groundwater Subbasin SNMP Stakeholders and Stakeholder Meetings

Stakeholders	Meetings	Topics
California Water Services Company City of Milpitas City of Mountain View City of Palo Alto City of San Jose City of Santa Clara City of Sunnyvale San Francisco Bay Regional Water Quality Control Board San Jose Water Company Santa Clara Basin Watershed Management Initiative Santa Clara County Farm Bureau South Bay Water Recycling Stanford University	May 31, 2011	• Introduction to SNMPs • Santa Clara Groundwater Subbasin Overview • Approach to developing SNMP • Stakeholder Input
	October 12, 2011	• SNMP Process • S/N Source Identification • Approach to Loading Estimates • Stakeholder Input
	April 11, 2013	• Overview of SWRCB Recycled Water Policy Update • Recycled water and stormwater goals • Basin Water Balance • Loading Estimates • Assimilative Capacity
	June 20, 2013	• Review of SNMP Process • Loading analysis results • Forecasted Assimilative Capacity • Causes of trends • Implementation Measures • SNMP Monitoring Plan

1.4 Related Plans and Policies

Several state, regional, and local water quality plans and policies are related to the SWRCB's Recycled Water Policy and its provision for the development of SNMPs. These plans and policies are discussed below.

1.4.1 Anti-Degradation Policy

The SWRCB adopted the Anti-Degradation Policy in 1968 (Resolution 68-16). This policy states that existing high water quality should be maintained and that dischargers should use best practicable treatment to avoid pollution. The policy provides for some degradation of water quality if such degradation is consistent with maximum benefits to the people of the state, will not unreasonably affect present and anticipated beneficial use of such water, and will not result in water quality less than that prescribed in Regional Water Quality Control Plans. Projects that are included in the SNMP will need to satisfy the requirements of the Anti-Degradation Policy.

1.4.2 Regional Water Quality Control Plan

Each RWQCB prepares a Water Quality Control Plan (Basin Plan) for their region. The Basin Plans are designed to achieve the highest water quality consistent with maximum benefit to the people of the State. The San Francisco Bay Basin Plan designates beneficial uses and water quality objectives for waters of the State, including surface waters and groundwater. The plan also includes implementation programs to achieve water quality objectives. The beneficial uses for northern Santa Clara County groundwater and associated water quality objectives related to salts and nutrients are discussed below.

1.4.2.1 Beneficial Uses

Existing and potential beneficial uses of groundwater in northern Santa Clara County are municipal and domestic water supply (MUN), industrial water supply (IND), industrial process supply (PROC), and agricultural water supply (AGR). Unless otherwise designated by the RWQCB, all groundwater is currently considered suitable, or potentially suitable, for municipal or domestic water supply.

1.4.2.2 Water Quality Objectives

The Basin Plan identifies water quality objectives for groundwater throughout the region. The maintenance of existing high quality of groundwater (i.e., "background") is the primary groundwater objective. At a minimum, groundwater may not contain concentrations of chemical constituents or substances producing taste and odor in excess of the objectives listed in Table 4. An exception is made when naturally occurring background concentrations are greater than the thresholds listed in Table 4.

As explained in Section 2.3, the water quality parameters used as surrogates for salt and nitrate in this SNMP are Total Dissolved Solids and Nitrate as NO_3. Table 4 lists numeric objectives for salt (as Total Dissolved Solids – TDS) and nutrients (as Nitrate) for municipal and domestic water supply (MUN) and agricultural water supply (AGR) beneficial uses.

Table 4 – Basin Plan Water Quality Objectives

Parameter	Units	MUN	AGR
TDS	mg/L	500	10,000
Nitrate (as NO3)	mg/L	45	
Nitrate + Nitrite (as N)	mg/L	10	30

1.4.3 Integrated Regional Water Management Plan Objectives

Water, wastewater, flood protection, and stormwater management agencies, together with cities, counties, and environmental interests, have developed an Integrated Regional Water Management (IRWM) Plan for the San Francisco Bay Area. IRWM is a collaborative effort to manage all aspects of water resources in a region. IRWM crosses jurisdictional, watershed, and political boundaries; involves multiple agencies, stakeholders, individuals, and groups; and, attempts to address the issues and differing perspectives of all the entities involved through mutually beneficial solutions. The Bay Area IRWM Plan specifies regional goals and objectives. Table 5 lists the regional goals and objectives that apply to salt and nutrient management planning for Santa Clara County groundwater:

Table 5 – San Francisco Bay Area Integrated Regional Water Management Plan Goals and Objectives

Regional Goal	Objectives
Promote Environmental, Economic, and Social Sustainability	• Minimize health impacts associated with polluted water. • Develop policies, ordinances and programs that promote IRWM goals, and determine areas of integration among projects. • Promote community education involvement and stewardship.
Contribute to improved supply reliability and quality	• Provide adequate water supplies to meet demands. • Provide clean, safe, and reliable drinking water. • Implement water use efficiency to meet or exceed state and federal requirements. • Increase recycled water use of potable water replaced by non-potable supply. • Expand water storage and conjunctive management of surface and groundwater. • Provide for groundwater recharge while protecting groundwater resources from overdraft. • Protection of groundwater resources from contamination.
Protect and improve watershed health and function	• Minimize point-source and nonpoint-source pollution. • Improve infiltration capacity. • Control pollutants of concern (TMDLs, 303(d) etc.) • Manage floodplains to reduce flood damages to homes, businesses, schools, and transportation.

1.4.4 District Board Ends Policies

The District Board has adopted Ends Policies that provide direction to staff on the intended results, organizational products, impacts, benefits, outcomes, recipients, and their relative worth. The following Ends Policies are related to salt and nutrient management planning:

1.1 An integrated and balanced approach in managing a sustainable water supply, effective natural flood protection, and healthy watersheds is essential to prepare for the future.

1.2 Effective public engagement in accomplishing the District mission is achieved through communication that involves the community and key stakeholder groups in a transparent and open manner.

2.1 Current and future water supply for municipalities, industries, agriculture and the environment is reliable.

2.1.1 Aggressively protect groundwater from the threat of contamination and maintain and develop groundwater to optimize reliability and to minimize land subsidence and saltwater intrusion.

2.1.2 Protect, maintain, and develop local surface water.

2.1.4 Protect, maintain, and develop recycled water.

The CEO has adopted interpretations of the Board policy. The interpretations include strategies to increase recycled water use to ten percent of total water demands by 2025 in partnership with the community and agencies in the county, and maintaining contaminant concentrations below Basin Plan water quality objectives in wells.

1.4.5 Groundwater Management Plan Basin Management Objectives

The purpose of the District's Groundwater Management Plan (GWMP) is to describe basin management objectives. Objectives include strategies, programs, and activities that support those objectives, and outcome measures to gauge performance (District, 2012b). A more detailed discussion of the GWMP, objectives, and outcome measures is provided in Appendix 2.

The GWMP establishes the following basin management objectives (BMOs):

- BMO 1: Groundwater supplies are managed to optimize water supply reliability and minimize land subsidence.

- BMO 2: Groundwater is protected from existing and potential contamination, including saltwater intrusion.

These BMOs describe the overall goals of the District's groundwater management program. The basin management strategies are the methods that will be used to meet the BMOs. Many of these strategies have overlapping benefits to groundwater resources and act to improve water supply reliability, minimize subsidence, and protect or improve groundwater quality. The strategies are listed below:

a. Manage groundwater in conjunction with surface water through direct and in-lieu recharge programs to sustain groundwater supplies and to minimize saltwater intrusion and land subsidence.

b. Implement programs to protect or promote groundwater quality to support beneficial uses.

c. Maintain and develop adequate groundwater models and monitoring systems.

d. Work with regulatory and land use agencies to protect recharge areas, promote natural recharge, and prevent groundwater contamination.

The District has developed the following outcome measures to gauge performance in meeting the basin management objectives:

Projected end of year groundwater storage is greater than 278,000 AF in the Santa Clara Plain and 5,000 in Coyote Valley.

a. Groundwater levels are above subsidence thresholds at the subsidence index wells.

b. At least 95% of countywide water supply wells meet primary drinking water standards and at least 90% of South County wells meet Basin Plan agricultural objectives.

c. At least 90% of wells in both the shallow and principal aquifer zones have stable or decreasing concentrations of nitrate, chloride, and total dissolved solids (TDS).

d. Programs and policies that achieve management of groundwater quality are described in Appendix 4.

1.5 Regulatory Framework

This section describes how S/N discharges to groundwater are regulated and controlled by regional and local agencies.

1.5.1 Waste Discharge Permitting Program

The RWQCB generally controls point source discharges to surface water through waste discharge requirements issued under the federal National Pollutant Discharge Elimination System (NPDES) permits. Although the NPDES program was established by the federal Clean Water Act the permits are prepared and enforced by the RWQCB per California's delegated authority for the act.

Issued in five-year terms, a NPDES permit usually contains components such as discharge prohibitions, effluent limitations, and necessary specifications and provisions to ensure proper treatment, storage, and disposal of the waste. The permit often contains a monitoring program that establishes monitoring stations at effluent outfall and receiving waters.

Under the state's Porter-Cologne Water Quality Control Act, any person discharging or proposing to discharge waste within the region (except discharges into a community sewer system) that could affect the quality of the waters of the state is required to file a Report of Waste Discharge (ROWD). The RWQCB reviews the nature of the proposed discharge and adopts Waste Discharge Requirements (WDRs) to protect the beneficial uses of waters of the

state. WDRs are issued for discharges to land, including discharge of treated wastewater to land, landfills, agricultural activities, and water recycling programs. Waste discharge requirements could be adopted for an individual discharge, or a specific type of discharges, in the form of a general permit. The RWQCB may waive the requirements for filing a ROWD or issuing WDRs for a specific discharge where such a waiver is not against the public interest. NPDES requirements may not be waived.

Acceptable control measures for point source discharges must ensure compliance with NPDES permit conditions, including discharge prohibitions and the effluent limitations specified in the Basin Plan. In addition, control measures must satisfy water quality objectives set forth in the Basin Plan unless the RWQCB judges that related economic, environmental, or social considerations merit a modification after a public hearing process has been conducted. Control measures employed must be sufficiently flexible to accommodate future changes in technology, population growth, land development, and legal requirements.

Table 6 summarizes general permits that the San Francisco Bay RWQCB has issued for discharges that could contribute salts and/or nutrients to groundwater. In addition, individual permits have been issued to the following types of operations:

- Food processing wastewater treatment and disposal.
- Alternative and large septic systems.
- Package sanitary wastewater treatment systems.

Individual orders are discussed further in Section 1.6 on potential S/N contributors and sources.

Table 6 – San Francisco Bay RWQCB General Orders for Discharges that Could Contribute Salt and Nutrients to Groundwater

Order Number	Name	Description
96-011	General Water Reuse Requirements for Municipal Wastewater and Water Agencies	The Order serves as a General Water Reuse Order authorizing municipal wastewater reuse by producers, distributors, and users of non-potable recycled wastewater throughout the region. The intent of this Order is to streamline the permitting process and delegate the responsibility of administrating water reuse programs to local agencies to the fullest extent possible. The Order is intended to serve as a region-wide general permit for publicly owned wastewater and water agencies that recycle treated municipal wastewater. It is intended to replace individual reuse Orders.
97-10-DWQ	Discharges to Land By Small Domestic Wastewater Systems	SWRCB general WDRs. Revisions being considered consistent with AB 885. Basin Plan includes criteria for onsite wastewater systems. Small systems are typically regulated by the County of Santa Clara in accordance with the Basin Plan and through delegation of authority from the RWQCB.
R2-2009-0074	Municipal Regional Stormwater NPDES Permit	Waste Discharge Requirements and NPDES Permit for the discharge of stormwater runoff from the municipal separate storm sewer systems of the following jurisdictions and entities: the cities of Campbell, Cupertino, Los Altos, Milpitas, Monte Sereno, Mountain View, Palo Alto, San Jose, Santa Clara, Saratoga, and Sunnyvale. Included are the towns of Los Altos Hills and Los Gatos, the Santa Clara Valley Water District, and Santa Clara County, which have joined together to form the Santa Clara Valley Urban Runoff Pollution Prevention Program (Santa Clara Permittees).

1.5.2 Total Maximum Daily Loads

Total Maximum Daily Loads (TMDLs) are action plans to restore clean water. Section 303(d) of the federal Clean Water Act requires that states identify water bodies -- bays, rivers, streams, creeks, and coastal areas -- that do not meet water quality standards, and the pollutants that impair them. TMDLs examine the water quality problems, identify sources of pollutants, and specify actions that create solutions. These plans have been adopted by the RWQCB as amendments to the region's Basin Plan.

Several water bodies within northern Santa Clara County do not meet water quality standards. The impairments that have been identified include mercury, PCBs, pesticides, sediment, and trash. None of these impairments are significant in terms of salt and nutrient management in groundwater.

1.5.3 Local Regulations

Local land use agencies also play a role in managing S/N loading to groundwater. Specific examples are listed here and enumerated further in Appendix 4.

- City and County General Plans provide policies and strategies for protecting water quality and maintaining water supply reliability.

- County Septic Ordinance regulates the location, construction, and operation of smaller septic systems, which are potential sources of salts and nutrients.

- County Design Guidelines for golf courses include guidelines related to water quality protection from fertilizers.

- Urban Runoff Management programs are typically implemented to meet the Municipal Regional Stormwater permit requirements and include provisions to protect water quality.

- Santa Clara Valley Water District Stormwater Infiltration Device Policy regulates the use of stormwater infiltration devices and is being updated to be consistent with Municipal Regional Stormwater permit requirements.

1.5.4 Goals and Objectives for Recycled Water and Stormwater

The District has established the following goals and objectives for recycled water and stormwater:

- Recycled Water:
  - Goal: Protect, maintain, and develop recycled water.
  - Objective: At least 10% of total annual county water demands are met with recycled water by 2025.

- Stormwater:
  - Goal: Promote natural recharge and the infiltration of high quality stormwater.
  - Objective: Maintain facilities to recharge about 50,000 AF of stormwater each year and evaluate opportunities to expand recharge capacity.

CHAPTER 2: GROUNDWATER SUBBASIN CHARACTERIZATION

This chapter describes the Santa Clara Groundwater Subbasin, which includes the Santa Clara Plain and the Coyote Valley areas (see Figure 1). Basin-wide groundwater attributes are described, including water balance, storage capacities, inflows and outflows for both the Santa Clara Plain and the Coyote Valley subareas. Trends in pumping, groundwater elevations, and groundwater quality are also included. The description of the subbasin provided in this chapter will aid in understanding the S/N source analysis that is presented in later chapters.

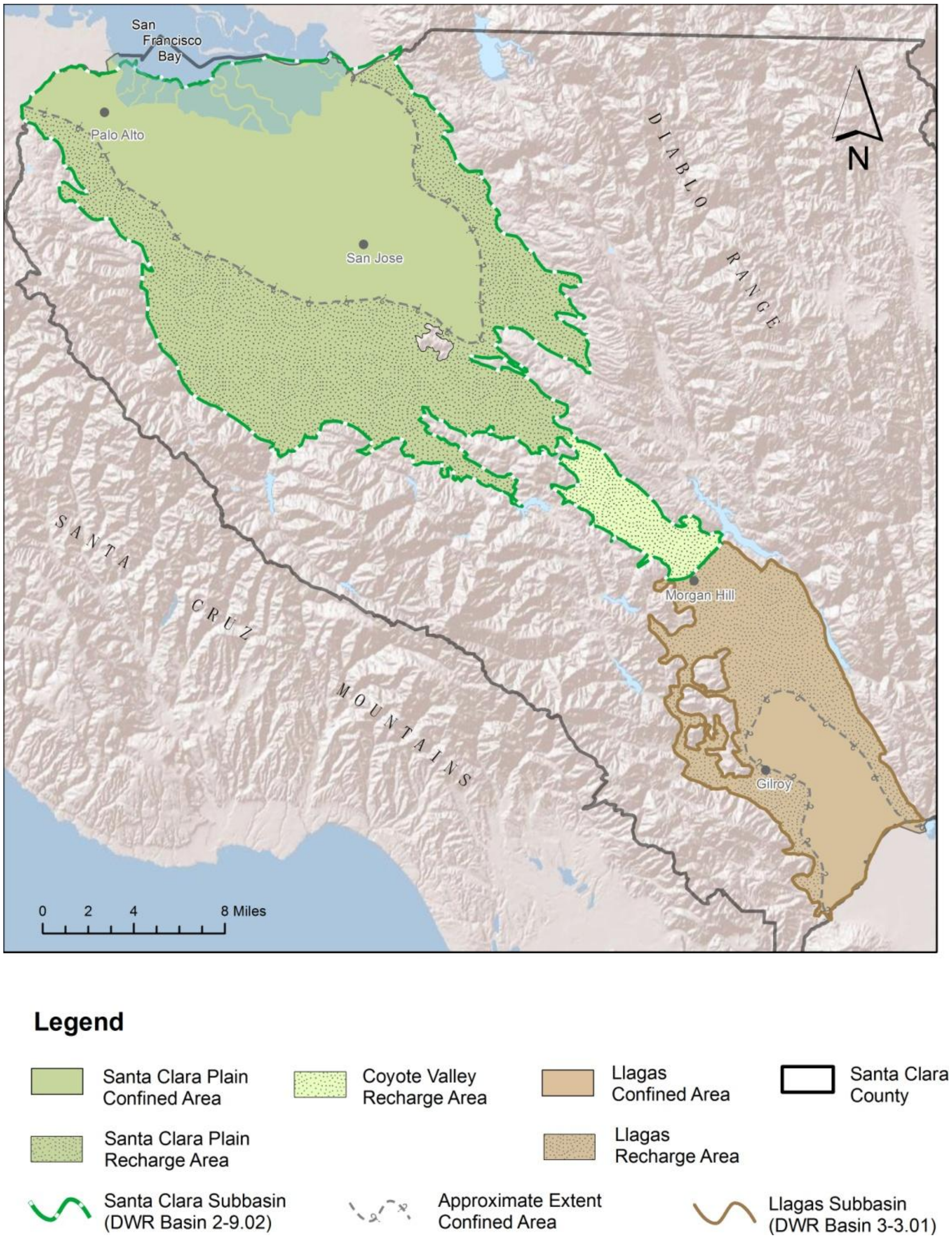

Figure 1 – Locations of Santa Clara Plain and Coyote Valley

2.1 Groundwater Basin

The groundwater basins in Santa Clara County transmit, filter, and store water. Water enters the basin through recharge areas and undergoes natural filtration as it is transmitted into deeper aquifers. Groundwater recharge and basin inflow replaces water removed from the basin by basin-outflow and by groundwater pumping. The District's managed aquifer recharge program maintains aquifer pressure, which helps avoid land subsidence. Storing surplus water in the groundwater basin enables part of the County's supply to be carried over from wet years to dry years.

Santa Clara County includes portions of two groundwater basins as defined by the California Department of Water Resources (DWR) Bulletin 118 Update 2003 – the Santa Clara Valley Basin (Basin 2-9) and the Gilroy-Hollister Valley Basin (Basin 3-3). The Santa Clara Valley Basin generally forms an elongated valley bounded by the Santa Cruz Mountains to the west and Diablo Range to the east, and extends north into San Mateo and Alameda Counties. The boundary between the Santa Clara Valley and the Gilroy-Hollister Valley Groundwater Basins is the Coyote Creek alluvial fan in the Morgan Hill area. The alluvial fan comprises a topographic and hydrologic divide between the groundwater and surface water flowing to the San Francisco Bay and water flowing to the Monterey Bay. The groundwater divide is approximately located at Cochrane Road in Morgan Hill. The boundary moves as much as a mile to the north or south depending on local groundwater conditions. The Santa Clara Groundwater Subbasin, which includes the Santa Clara Plain and Coyote Valley subareas, is located in the Santa Clara Valley Basin. The Llagas Groundwater Subbasin is located within the Gilroy-Hollister Valley Groundwater Basin. A separate SNMP has been prepared for the Llagas Groundwater Subbasin (Todd Groundwater, 2014).

While basin boundaries are primarily based on geologic and hydrologic information, subbasins are commonly based on institutional boundaries. DWR Bulletin 118 Update 2003 states that "subbasins are created for the purpose of collecting and analyzing data, managing water resources, and managing adjudicated basins." The Santa Clara Groundwater Subbasin, as defined by DWR, extends from the southern boundary of the Santa Clara Valley Basin in Morgan Hill north to the San Francisco Bay and the county boundaries. The subbasin includes two study areas – the Santa Clara Plain and the Coyote Valley. Although hydraulically connected to the Santa Clara Plain, the District refers to the Coyote Valley separately since it is largely an agricultural area and water supply is provided exclusively by municipal, domestic, and agricultural wells. The Santa Clara Plain portion of the Santa Clara Groundwater Subbasin is largely urban/suburban and primarily served by major water retailers using both groundwater and treated surface water. Some of the groundwater supplied to customers in the Santa Clara Plain is pumped in Coyote Valley.

2.1.1 Santa Clara Plain Hydrogeology

The Santa Clara Plain is the northern area of the Santa Clara Groundwater Subbasin, which is the southern extension of the Santa Clara Valley Groundwater Basin. The Santa Clara Plain is 280 square miles, comprising a large trough-like depression filled with alluvium, or unconsolidated sediments such as gravel, sand, silt, and clay, that were deposited from the mountains by water and gravity into the valley. The alluvium comprises inter-fingering alluvial fans, stream deposits, and terrace deposits The thickness of the alluvium varies from a few feet

at the subbasin boundaries to over 1,500 feet in the basin interior.[3] The alluvium thins towards the western and eastern edges of the Santa Clara Plain.

The Santa Clara Plain is divided into confined and recharge (unconfined) areas (Figure 1). The recharge area includes the alluvial fan and deposits found along the edge of the groundwater subbasin where high lateral and vertical sediment allow surface water to infiltrate the aquifers. Surface water replenishes unconfined groundwater within the recharge area and contributes to the recharge of deep aquifers in the confined area through subsurface flow. As groundwater pumping exceeds natural recharge, the District operates managed groundwater recharge facilities within the recharge area to replenish groundwater storage.

The confined area of the Santa Clara Plain is located in the northern and central portion of the subbasin. It is characterized by upper and lower aquifers, divided by laterally extensive, low-permeability clays and silts, which restrict the vertical flow of groundwater. The District refers to these aquifers as the shallow and principal aquifer zones. The shallow and principal aquifer zones are represented by wells primarily drawing water from depths less than and greater than 150 feet, respectively. The principal aquifer zone is less vulnerable to contamination than shallow aquifers since the confining layers also restrict the movement of contaminants that may be present in infiltrating water. The boundary between the confined and recharge areas is a simplification of the natural conditions in the subbasin and two prior versions of this boundary have been published by the USGS[4] and State Water Resources Control Board.[5] A generalized cross-section of the Santa Clara Plain is shown in Figure 2.

Groundwater in the Santa Clara Plain is found at different depths in the unconfined aquifer and under artesian conditions in the confined aquifer. Groundwater movement generally follows surface water patterns, flowing to the northwest. Local groundwater also moves toward areas of intense pumping. Regional groundwater elevations in the Santa Clara Plain range from 60 to 90 feet below sea level in the middle of the subbasin, to 220 to 480 feet above mean sea level near the southern extent of the eastern and western hills of the Santa Clara Plain. There has been a significant recovery in groundwater levels since the District's managed groundwater recharge program was started. As seen in the hydrograph (Figure 3) typical seasonal fluctuations are about 10 to 20 feet.

2.1.2 Santa Clara Plain Pumping and Recharge

In 2010, groundwater pumping in the Santa Clara Plain was approximately 81,100 AF. As shown on Figure 4, 96% of the water pumped was for municipal and industrial uses, with minor amounts used for agriculture and domestic purposes. Figure 4 also shows the number of wells reporting groundwater pumped for each of these uses in 2010. It should be noted that a single well may be used for more than one purpose. Water retailer pumping accounted for nearly 90% of the groundwater pumped from the Santa Clara Plain in 2010. Although there is some variation from year to year, this represents typical recent pumping patterns for the Santa Clara Plain.

Subbasin water levels reflect the amount of groundwater in storage and are strongly influenced by groundwater pumping. The distribution and pumping of these wells for 2010 indicate that the

[3] Santa Clara Valley Water District, Standards for the Construction and Destruction of Wells and other Deep Excavations in Santa Clara County, June 1989.
[4] USGS, Ground water in Santa Clara Valley, California, Water-Supply Paper 519, 1924.
[5] California State Water Resources Control Board, Santa Clara Valley Investigation, Bulletin Number 7, 1955.

greatest numbers of high production wells (500 to 4,000 AF per year) are in the central and southern portion of the Santa Clara Plain as shown in Figure 5.

The annual groundwater production for the Santa Clara Plain is shown in Figure 2–6. For the time period shown, the maximum groundwater production of 181,000 AF in the Santa Clara Plain occurred in 1985. A sharp decrease in groundwater production in the Santa Clara Plain can be noted in 1989, the year that the District's third and largest water treatment plant (Santa Teresa) came on-line to utilize water imported from the Central Valley Project. Prior to 1989, the average annual pumping in the Santa Clara Plain was 157,000 AF. After the Santa Teresa plant came on-line, average pumping dropped to 106,000 AF per year. Managed recharge provides the majority of water available for groundwater production, as shown in Table 7 and Figure 6.

The Santa Clara Groundwater Subbasin is actively managed by the District. On average, more than 76,000 acre-feet per year (AF/yr) of local reservoir and imported water are percolated into Santa Clara Groundwater Subbasin aquifers through the District's Managed Aquifer Recharge programs. The addition of water through planned or incidental recharge sustains the groundwater supply, and can improve water quality by diluting existing contaminants in the aquifer, diminish water quality by introducing contaminants[6], or induce geochemical changes in the aquifers. The District has been recharging local reservoir water into the aquifers since the 1930s and water imported from the Sacramento-San Joaquin Delta since the 1960s.

The District's managed recharge program is an important management tool that has contributed to aquifer storage recovery, cessation of unacceptable levels of inelastic land subsidence, and improved water quality in impacted areas. Another important influence on groundwater quality is infiltration from applied irrigation water or stormwater. Applied irrigation water from any source can contribute salt and other constituents. Recycled water has a higher concentration of S/Ns than groundwater or treated water. Salts and Nutrients are introduced to groundwater through landscape irrigation with tertiary treated recycled water. Recycled water producers are actively pursuing advanced treatment and other measures to reduce the salinity of recycled water. For example, the District constructed the Silicon Valley Advanced Water Purification Center that produces water with TDS that is about 5% of tertiary treated recycled water. The City of Palo Alto has achieved recycled water salinity reduction by repairing sections of submerged sewer lines subject to infiltration of saline groundwater near the Bay.

[6] The District's Recharge Water Quality Monitoring Program periodically confirms that only high quality water is used to recharge the subbasin.

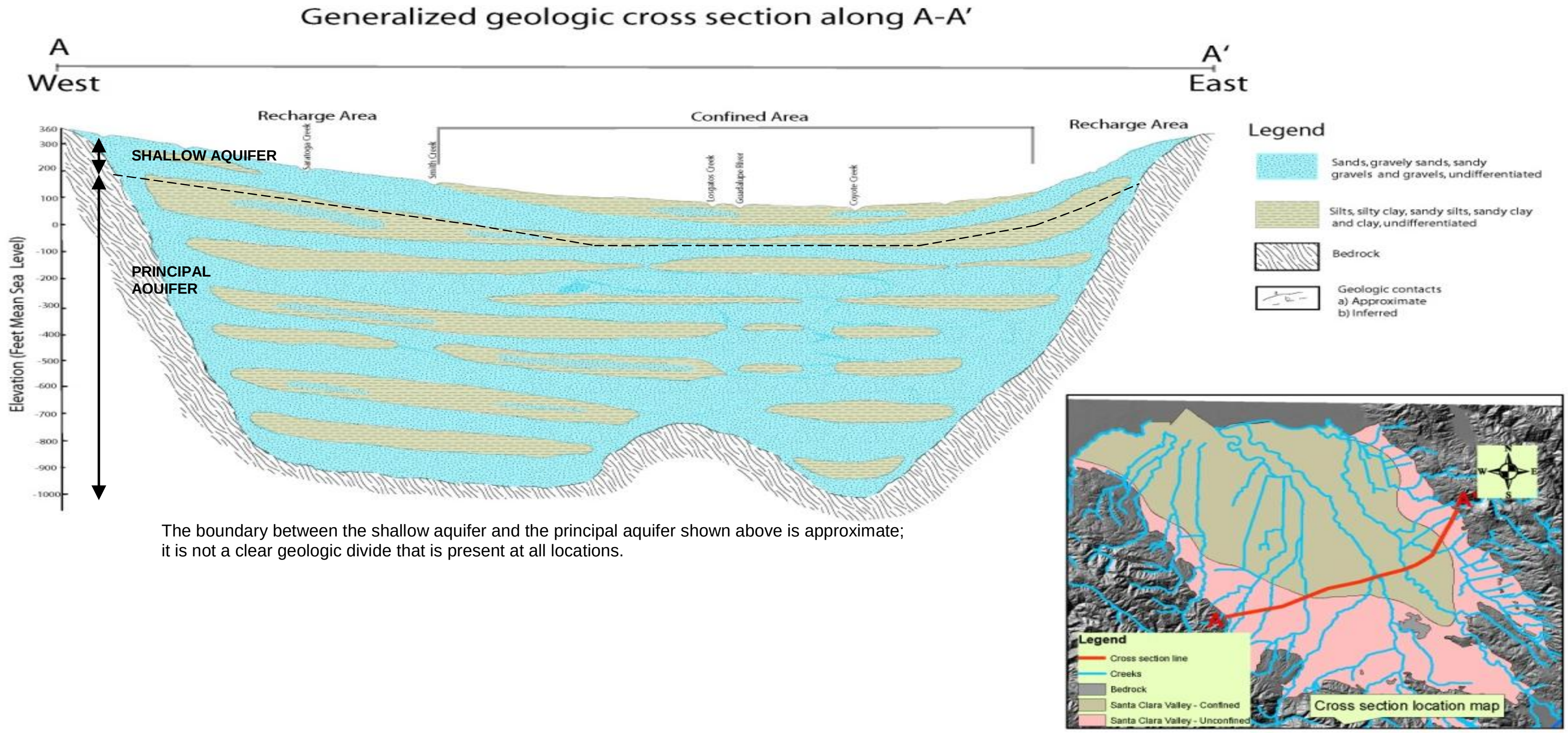

Figure 2 – Generalized Geologic Cross-Section of the Santa Clara Plain

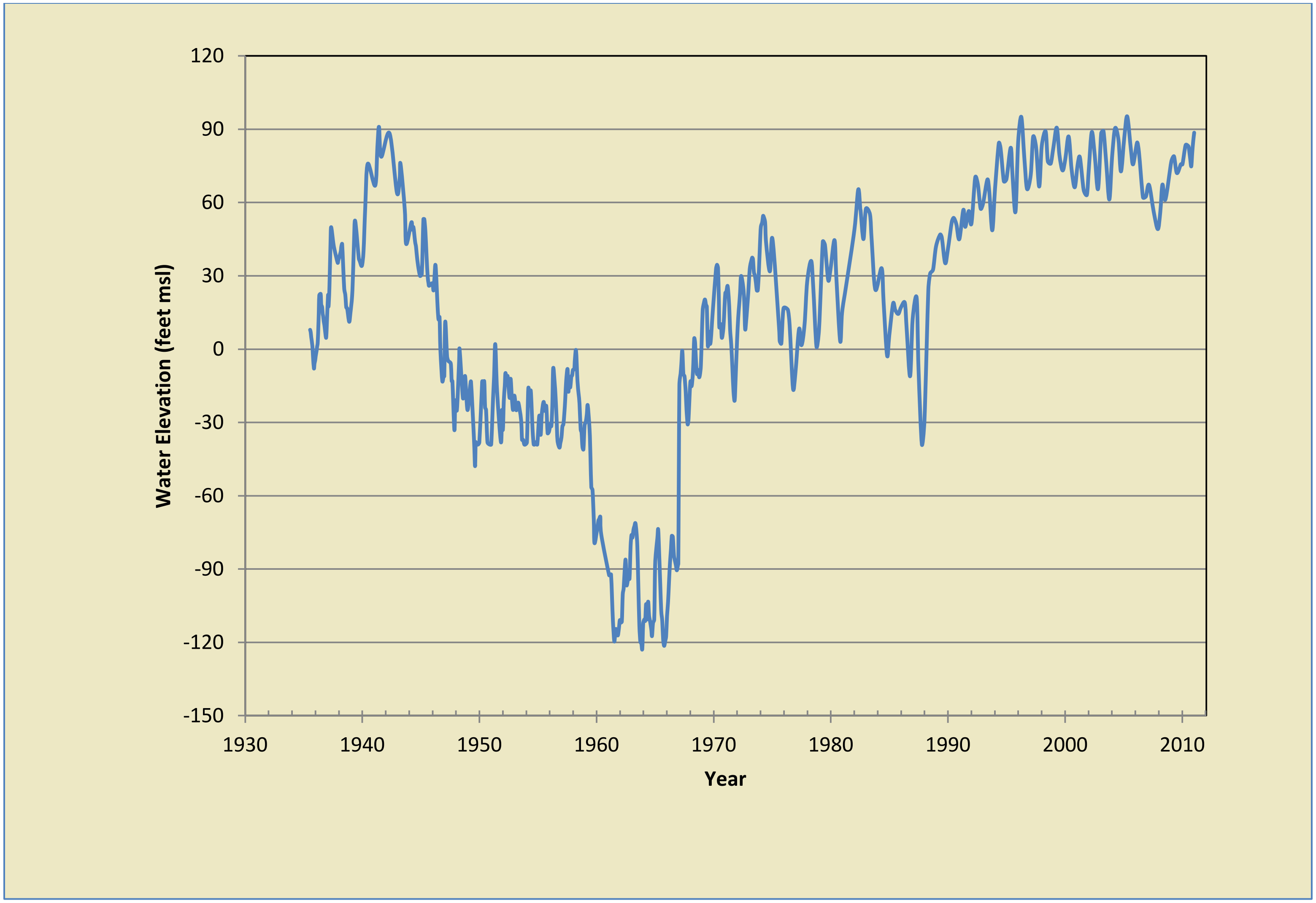

Figure 3 – Santa Clara Plain Index Well Hydrograph

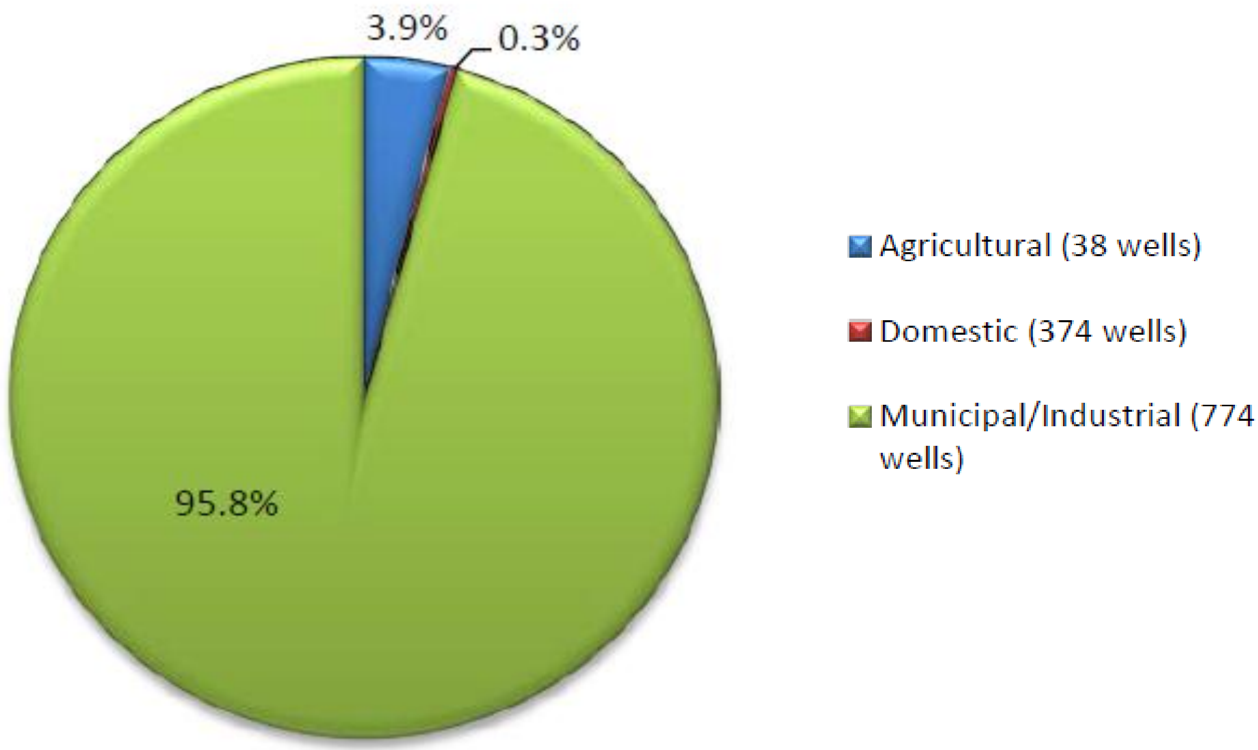

Figure 4 – Santa Clara Plain 2010 Groundwater Use

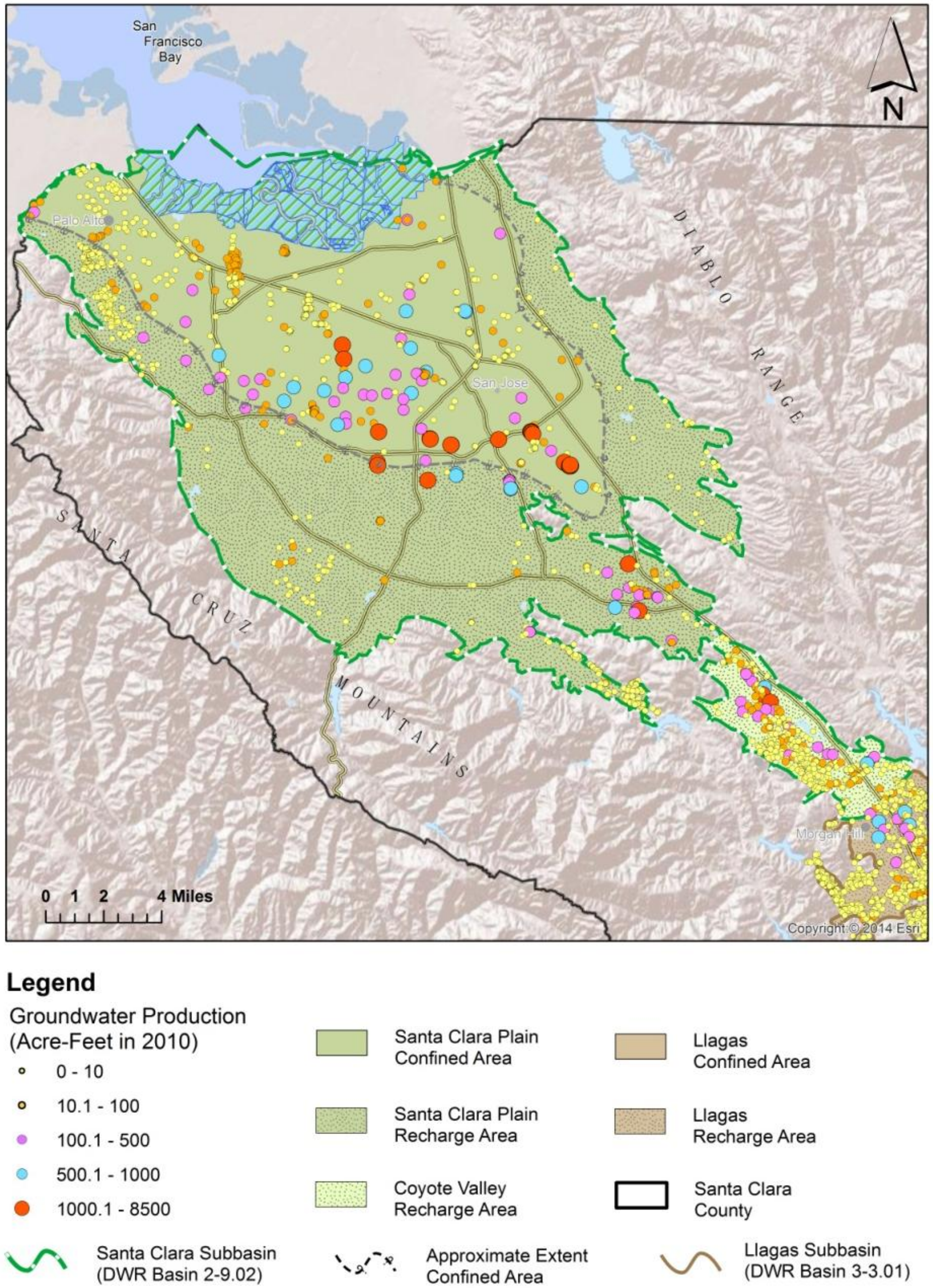

Figure 5 – 2010 Groundwater Pumping in the Santa Clara Groundwater Subbasin

Table 7- Santa Clara Plain Principal Aquifer Water Budget (2002 to 2011)

Water Budget Component	Acre-Feet
Inflow	
Managed Recharge	64,000
Natural Recharge	30,000
Subsurface Inflow	8,000
Total Inflow	102,000
Outflow	
Groundwater Pumping	95,000
Subsurface Outflow	6,000
Total Outflow	101,000
Change in Storage	1,000

Notes:

1. Managed recharge represents direct replenishment by the District using local and imported water.
2. Natural recharge includes all uncontrolled recharge, including the deep percolation of rainfall, septic system and/or irrigation return flows, and natural seepage through creeks.
3. Subsurface inflow represents inflow from adjacent aquifer systems, including inflow from the Coyote Valley.
4. Groundwater pumping is based on pumping reported by water supply well owners.
5. Subsurface outflow represents outflow to adjacent aquifer systems, including outflows to San Francisco Bay.

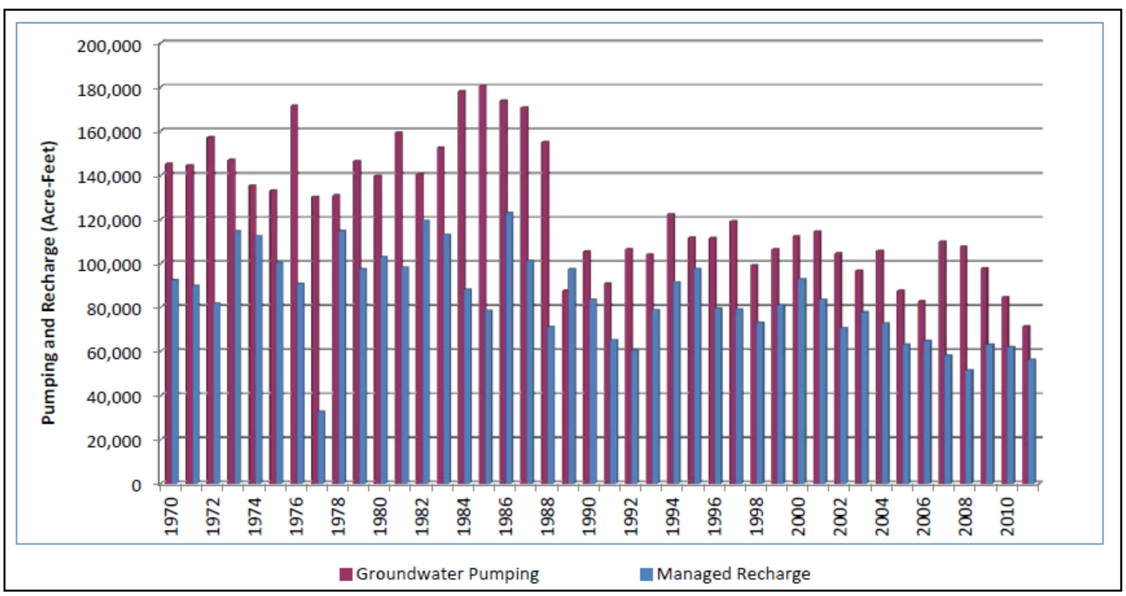

Figure 6 – Santa Clara Plain Groundwater Pumping and Managed Recharge

2.1.3 Santa Clara Plain Groundwater Elevation Trends

Groundwater elevations are affected by natural and managed recharge and groundwater extraction, and are an indicator of how much groundwater is in storage at a particular time. Both low and high elevations can cause adverse conditions. Low groundwater levels can lead to land subsidence or saltwater intrusion, and high water levels can lead to groundwater intrusion into basements, parking garages, elevator shafts, and other below-ground structures.

Figure 7 depicts changes in groundwater elevations over the last hundred years for the Santa Clara Plain. Annual fluctuations reflect recharge in winter and spring and pumping in summer.

The increase in groundwater elevations through the late 1930s and 1940s are attributed to the expansion of the District's conjunctive use program. An increase in groundwater elevations are also attributed with the construction of the District's local reservoirs and increased volumes of recharge utilizing reservoir releases. Downward trends beginning in 1940 are a result of increased agricultural pumping. Long term declines, starting in the late 1940s and later, reflect growing municipal and industrial demands in Silicon Valley that correlate with rapid population growth. The increase in groundwater elevations in the late 1960s and 1970s is due to the delivery of State Water Project water through the South Bay Aqueduct, and the completion of the District's Rinconada and Penitencia Water Treatment Plants. Even with a significant drought from 1987 to 1992, groundwater elevations improved beginning in 1989 with the addition of federal Central Valley Project deliveries and the completion of the Santa Teresa Water Treatment Plant.

2.1.4 Santa Clara Plain Storage Capacity

The operational storage capacity of the Santa Clara Plain has been estimated to be 350,000 AF.[7] The operational storage capacity represents the volume of groundwater that can be stored while avoiding adverse impacts such as inelastic land subsidence and saltwater intrusion. The District is currently working to refine this estimate based on historically observed data.

2.1.5 Santa Clara Plain Water Budget

A water budget for the Santa Clara Plain for calendar years 2002 through 2011 is shown in Table 7. The water budget is based on the District groundwater flow model[8] for the Santa Clara Plain, and represents inflows and outflows for the principal aquifer. A majority of the inflow to the Santa Clara Plain is a result of managed recharge of local and imported supplies. Although the water budget can vary significantly from year to year, on average, there was a slight annual increase in storage for the Santa Clara Plain over this 10-year period.

[7] Santa Clara Valley Water District, 2012 Groundwater Management Plan

[8] The District uses MODFLOW to forecast groundwater supply and assess the annual water budget. Separate MODFLOW models are used for Santa Clara Plain, Coyote Valley, and the Llagas Subbasin.

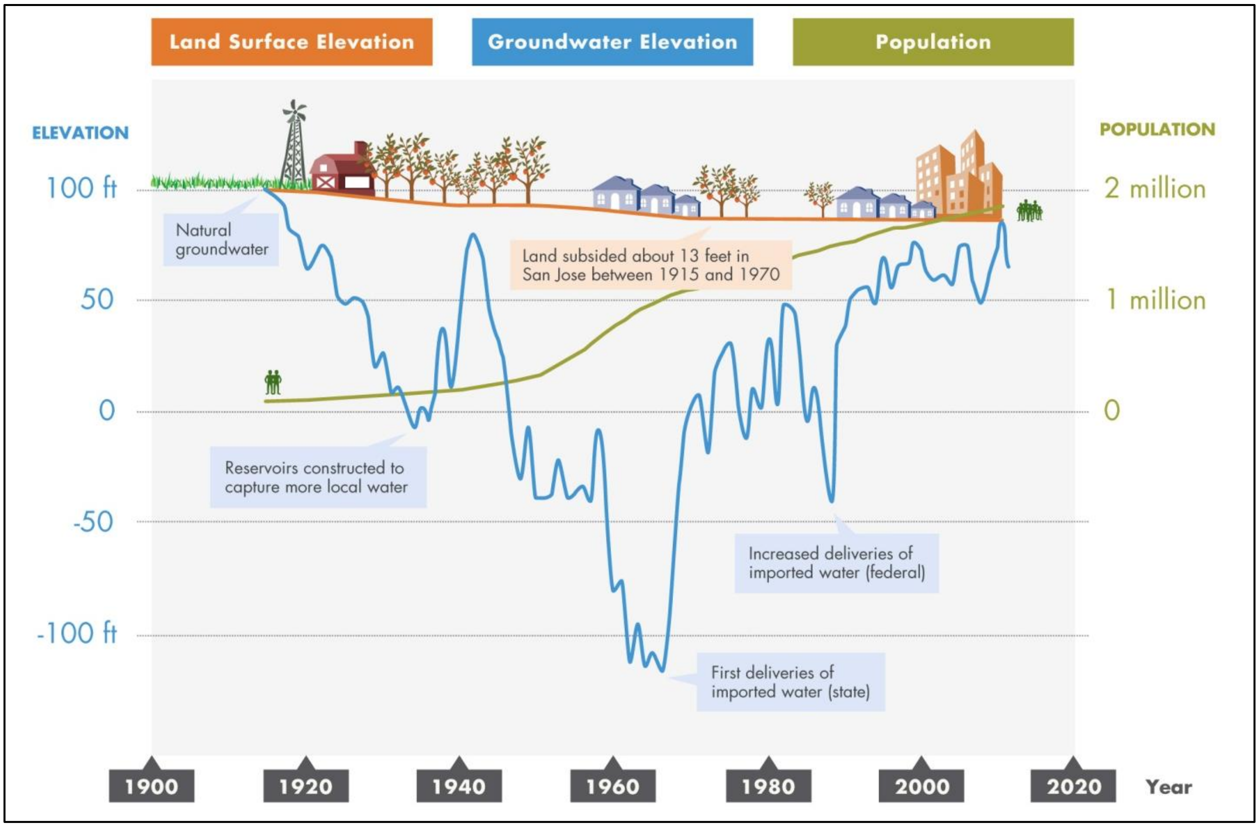

Figure 7 – Historical Water Levels, Land Subsidence, and Groundwater Recharge Milestones

2.1.6 Santa Clara Plain Groundwater Quality

The Santa Clara Plain generally produces water of excellent quality for municipal, irrigation, and domestic supply. Within the Santa Clara Plain calcium and magnesium constitute the principal cations, and bicarbonate as the most prevalent anion. The total dissolved solids (TDS) content is typically 200 to 500 mg/L, with the exception of localized areas including the Evergreen area of San Jose, and all of Palo Alto (see Figure 17). The median TDS content for the principal aquifer zone is 400 mg/L. The median is the preferred statistic to represent water quality because it represents the middle of the data set and is less affected by outliers and skewed data.

Some shallow aquifers adjacent to the San Francisco Bay have been affected by saltwater intrusion. High TDS is also noted in some wells close to the Bay. Very few wells sampled each year contain contaminants above primary MCLs.[9] A summary of the shallow and principal aquifer water quality from 2002 to 2011 is presented in Tables 8 and 9. Groundwater quality is discussed in more detail in section 2.5.

[9] Santa Clara Valley Water District, 2012 Groundwater Quality Report.

Table 8 – Santa Clara Plain Shallow Aquifer Zone[1] Groundwater Quality Summary Statistics

Parameter[2]	2002 – 2011 Results[3]			Population Median[4]		MCL[5]		n[6]
	25th Percentile	50th Percentile (Median)	75th Percentile	Lower	Upper	Primary	Secondary	
Nitrate as NO_3 (mg/L)	0.30	1.4	6.4	0.60	3.3	45	NE	35
Total Dissolved Solids (mg/L)	410	588	840	440	820	NE	500	31

Table 9 – Santa Clara Plain Principal Aquifer Zone[1] Groundwater Quality Summary Statistics

Parameter[2]	2002 – 2011 Results[3]			Population Median[4]		MCL[5]		n[6]
	25th Percentile	50th Percentile (Median)	75th Percentile	Lower	Upper	Primary	Secondary	
Nitrate as NO_3 (mg/L)	4.2	9.3	20.8	8.1	10.7	45	NE	288
Total Dissolved Solids (mg/L)	337	400	490	384	410	NE	500	273

Notes:

1. The shallow aquifer zone is represented by wells primarily drawing water from depths less than 150 feet, while the principal aquifer zone is represented by wells primarily drawing water from depths greater than 150 feet.
2. mg/L = milligrams per liter (or parts per million)
3. The percentile is the value below, which a certain percent of observations fall (e.g., the 50th percentile, or median, is the value below which half of the observations fall). For parameters with results reported at multiple reporting limits, the Maximum Likelihood Estimate (MLE) method is used.
4. The lower and upper estimates of the population median are determined using a 95% confidence interval (alpha = 0.05).
5. Primary and secondary MCLs are from the California Code of Regulations. Primary MCLs are health-based drinking water standards, while secondary MCLs are aesthetic-based standards. For secondary MCLs with a range, the lower, recommended threshold is shown. NE= Not Established
6. n represents the number of wells tested.

2.2 Coyote Valley Hydrogeology

The Coyote Valley is the southern extension of the Santa Clara Valley Groundwater Basin, covering a surface area of 17 square miles. The Coyote Valley is approximately 7 miles long, and ranges from 3 miles wide to about a half mile wide at the boundary with the Santa Clara Plain to the north. The alluvial sediments overlying the Santa Clara Formation vary in thickness from a few feet or less along the west side of the subbasin, to more than 400 feet along the east side. The alluvial sediments are mainly composed of thick sequences of alluvial sand and gravel with inter-bedded thin and discontinuous clays. The absence of a continuous horizon of clay limits the delineation of shallow and principal aquifers in Coyote Valley. Accordingly, the Coyote Valley alluvium is treated as a single unconfined aquifer. A generalized cross-section of the Coyote Valley is presented in Figure 8.

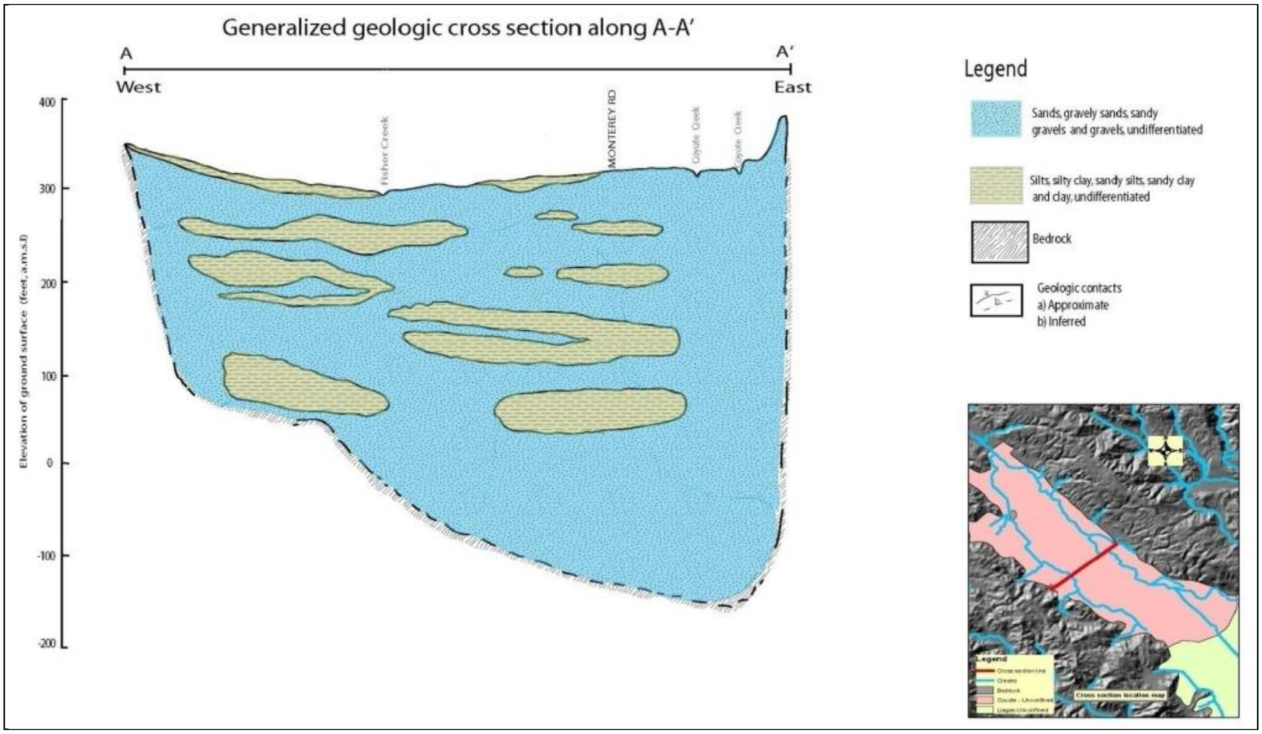

Figure 8 – Coyote Valley Generalized Cross Section

The Coyote Valley is generally unconfined and groundwater is typically encountered between 5 and 40 feet below ground surface. Groundwater movement follows surface water patterns, flowing to the northwest and draining into the Santa Clara Plain. Regional groundwater elevations in Coyote Valley range from 200 to 220 feet near the Coyote Narrows, to about 350 feet at Cochrane Road in Morgan Hill.

Groundwater levels in the Coyote Valley respond rapidly to changes in hydrology and pumping. Local groundwater moves toward areas of intense pumping, especially at the southeastern and northern parts of the subbasin where retailer groundwater production wells are located. Groundwater recharge occurs along Coyote Creek due to the District managed recharge releases from Anderson Reservoir and stream seepage. The District does not have off-stream managed groundwater recharge facilities in the Coyote Valley.

2.2.1 Coyote Valley Pumping

In 2010, groundwater pumping in the Coyote Valley was approximately 12,300 AF. As shown on Figure 9, 53% of groundwater pumped was for municipal and industrial uses (M&I), and 45% of groundwater pumped was used for agriculture. Only 2% of groundwater pumping was for domestic use. Pumping by water retailers accounted for over 60% of pumping in the Coyote Valley in 2010. Although there is some variation from year to year, this figure represents typical recent pumping patterns for the Coyote Valley.

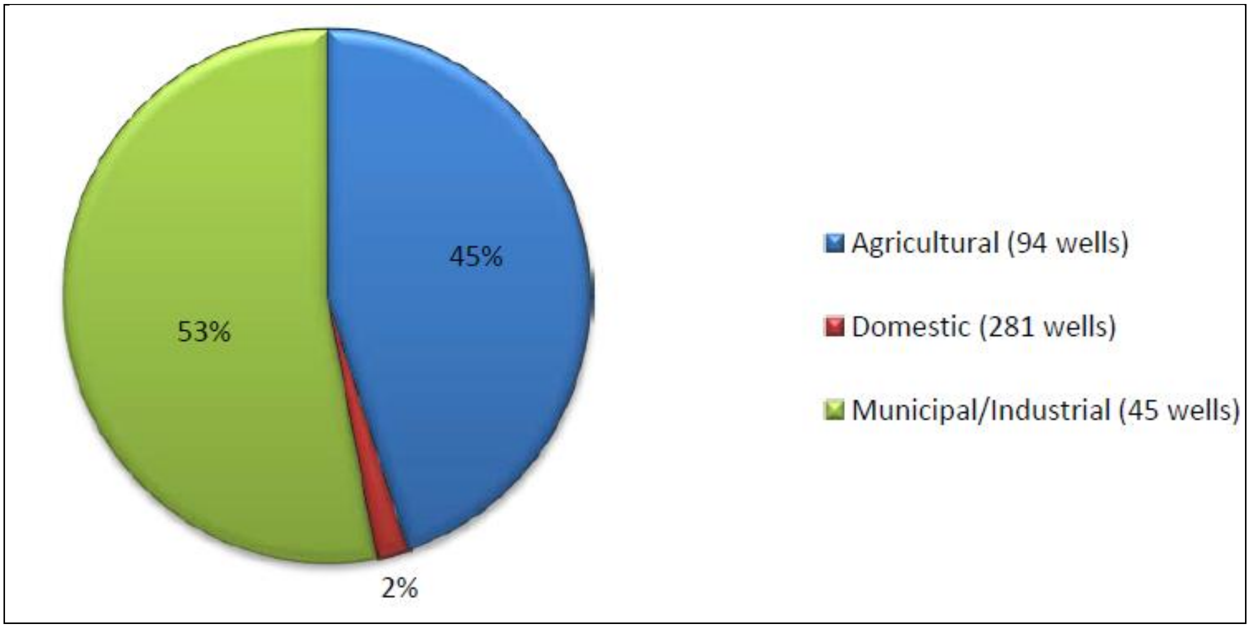

Figure 9 – Coyote Valley 2010 Groundwater Use

2.2.2 Coyote Valley Groundwater Pumping Trends

As shown in Figure 6, high production wells (500 to 4,000 AF/yr) are in the southern portion of the Coyote Valley. The District assumed management of the Coyote Valley and Llagas Subbasin in 1987; prior to that date, limited groundwater pumping data are available. Coyote Valley groundwater production remained fairly consistent until 2006, when new water retailer wells began pumping water to serve customers in the Santa Clara Plain. Managed recharge provides the majority of water available for groundwater production, as shown in Table 10 and Figure 10. Managed recharge in the Coyote Valley supports the maintenance of subsurface flows to the Santa Clara Plain.

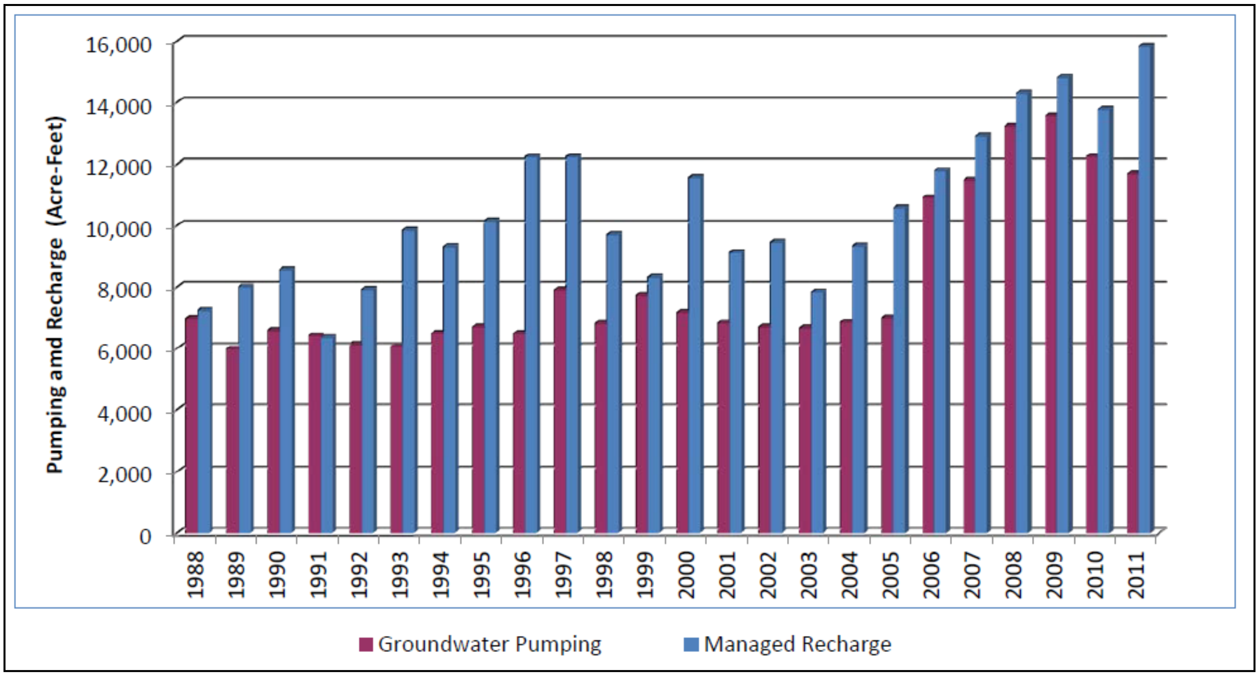

Figure 10 – Coyote Valley Groundwater Pumping and Managed Recharge

2.2.3 Coyote Valley Storage Capacity

The operational storage capacity of the Coyote Valley ranges between 23,000 and 33,000 AF.[10] The District is currently working to refine the operational storage capacity estimate based on historically observed data.

2.2.4 Coyote Valley Water Budget

Average Coyote Valley inflows and outflows for calendar years 2002 to 2011 are presented in Table 10. The Coyote Valley is dependent on Coyote Creek for its water supply, which is largely fed by releases from the Anderson-Coyote reservoir system. Imported water from the San Felipe Project can also be released to Coyote Creek. Natural recharge from rainfall and other sources typically account for less than 25% of the inflows to the Coyote Valley. Over the 10-year period evaluated, the Coyote Valley has seen a slight annual decrease in storage.

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[10] Santa Clara Valley Water District, Operational Storage Capacity of the Coyote and Llagas Groundwater Subbasins, April 2002.

Table 10 – Coyote Valley Water Budget (2002 to 2011)

Water Budget Component	Acre-Feet
Inflow	
Managed Recharge	12,000
Natural Recharge	2,500
Subsurface Inflow	0
Total Inflow	14,500
Outflow	
Groundwater Pumping	10,000
Subsurface Outflow	5,000
Total Outflow	15,000
Change in Storage	**-** 500

Notes:

1. Managed recharge represents direct replenishment by the District using local and imported water.
2. Natural recharge includes all uncontrolled recharge, including rainfall, septic system and/or irrigation return flows, and natural seepage through creeks.
3. Subsurface inflow represents inflow from adjacent aquifer systems.
4. Groundwater pumping is based on pumping reported by water supply well owners.
5. Subsurface outflow represents outflow to adjacent aquifer systems.

2.2.5 Coyote Valley Groundwater Elevation Trends

Groundwater elevations are affected by natural and managed recharge and groundwater extraction, and are an indicator of how much groundwater is in storage at a particular time. Groundwater elevations have been relatively stable since about 1970, although there has been a slight decreasing trend since the late 1990's. A typical hydrograph is shown in Figure 11.

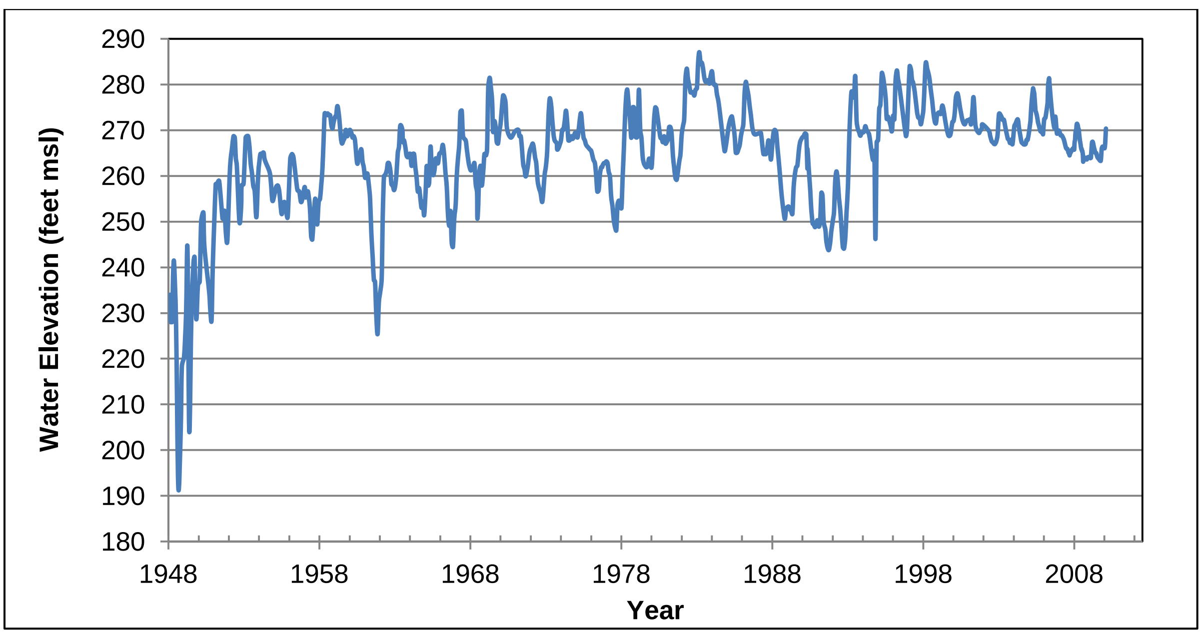


Figure 11 – Groundwater Elevation in Coyote Valley Well 09S02E02J002

2.2.6 Coyote Valley Groundwater Quality

The Coyote Valley produces water of good quality for municipal, irrigation, and domestic supply. The typical water type is dominated by calcium-magnesium and bicarbonate. The median TDS concentration is 368 mg/L, which is below the recommended secondary MCL of 500 mg/L. The median nitrate concentration is 15 mg/L, below the MCL of 45 mg/L. Typically, very few wells sampled each year contain contaminants above primary MCLs. A summary of Coyote Valley water quality data is presented in Table 11. Groundwater quality is discussed in more detail in section 2.5.

Table 11 – Coyote Valley Groundwater Quality Summary Statistics

Parameter[1]	2002 – 2011 Results[2]			Population Median[3]		MCL[4]		n[5]
	25th Percentile	50th Percentile (Median)	75th Percentile	Lower	Upper	Primary	Secondary	
Nitrate as NO_3 (mg/L)	3.7	15.0	43.0	4.5	29.8	45	NE	39
Total Dissolved Solids (mg/L)	320	368	414	328	405	NE	500	29

Notes:

1. mg/L= milligrams per liter (parts per million)
2. The percentile is the value below, which a certain percent of observations fall (e.g., the 5[0th] percentile, or median, is the value below which half of the observations fall). For parameters with results reported at multiple reporting limits, the Maximum Likelihood Estimate (MLE) method is used**.**
3. The lower and upper estimates of the population median are determined using a 95% confidence interval (alpha = 0.05).
4. Primary and secondary MCLs are from the California Code of Regulations. Primary MCLs are health-based drinking water standards, while secondary MCLs are aesthetic-based standards. For secondary MCLs with a range, the lower, recommended threshold is shown. NE= Not Established
5. n represents the number of wells tested.

2.3 Sources of Supply

A majority of the inflow to the Santa Clara Plain is a result of artificial recharge of local and imported supplies. Even with supplemental recharge, groundwater alone provides insufficient water supply to support this heavily developed area. Treated surface water deliveries have been critical to the area for half a century – first with SFPUC Hetch-Hetchy delivery to local water retailers, and later with District treated water deliveries. The Los Gatos, Westside, Penitencia, Guadalupe, and the Coyote Valley recharge systems are operated to actively recharge the Santa Clara Plain using imported and local reservoir water.

The Coyote Valley is almost entirely dependent on Coyote Creek for its water supply, which is largely fed by releases from the Anderson-Coyote reservoir system. Imported water from the Federal Central Valley Project may also be released to Coyote Creek.

2.4 Santa Clara Groundwater Subbasin Water Budget

The water budget for the Santa Clara Groundwater Subbasin is summarized in Figure 12. Long-term groundwater pumping for the Santa Clara Plain averages about 95,000 AF per year

based on data from 2002 to 2011. Historical pumping has been as high as 180,000 AF per year. The subsurface outflow from the Santa Clara Plain, which includes outflow to the San Francisco Bay, was 6,000 AF per year. Average recharge to the Santa Clara Plain is estimated to be 102,000 AF per year with sources including the District's managed recharge of local and imported water, deep percolation of rainfall, natural seepage from creeks, and subsurface inflow from surrounding hills (mountain front recharge). Two-thirds of recharge to the Santa Clara Plain comes from the District's managed recharge program. Subsurface inflow from adjacent aquifer systems is estimated to be 8,000 AF per year. The average annual change in groundwater storage between 2002 and 2011 is approximately 500 AF.

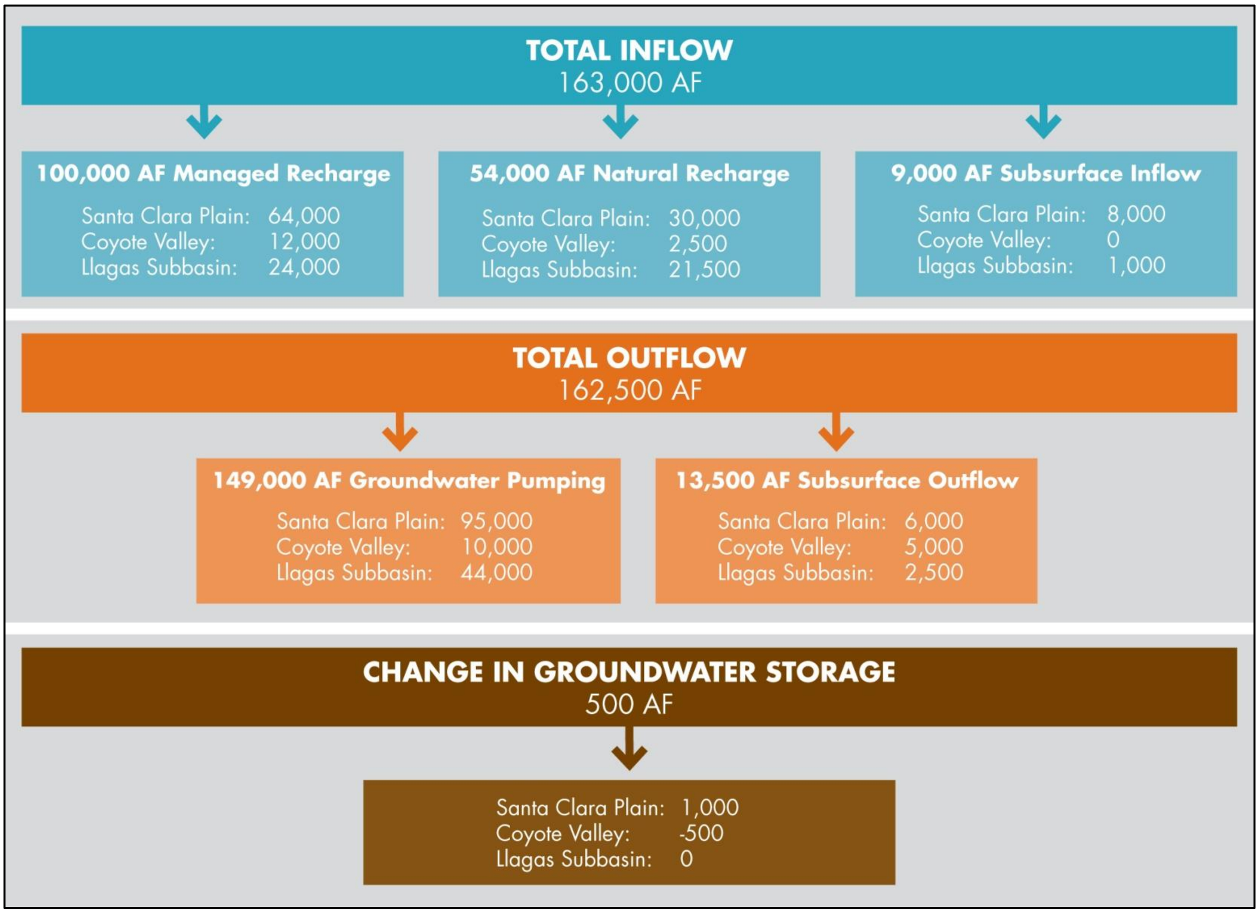


Figure 12 – 2002–2011 Average Groundwater Budget for the Santa Clara Plain and Coyote Valley

The Coyote Valley water budget is based on the District groundwater flow model for the Coyote Valley, and represents general inflows and outflows. The natural recharge term used in the budget is the sum of mountain front recharge, stream seepage, rainfall, septic return, and agricultural and landscape return. The net subbasin outflow term represents the combination of subsurface outflow to the Santa Clara Plain aquifers gaining reaches of streams and evapotranspiration.

2.5 Groundwater Quality – Salts and Nutrients

The District monitors groundwater quality throughout Santa Clara County to evaluate groundwater quality with respect to the RWQCB's Basin Plan Water Quality Objectives, and to provide data needed to support protection of the long-term reliability of the resource. Data on a variety of water quality constituents is collected and analyzed on an annual basis. The results of testing by the District and water suppliers are compared to drinking water standards and Basin Plan Agricultural Objectives. In addition, trends for key constituents are evaluated. This section focuses on water quality parameters pertinent to salt and nutrient management, including nitrate and total dissolved solids (TDS) in the Santa Clara Groundwater Subbasin and is based on the District's 2010 Groundwater Quality Report.[11]

2.5.1 Total Dissolved Solids

Total Dissolved Solids (TDS) is a measure of the combined content of all solutes in a water sample. It is a prime indicator of the general suitability of water, especially for domestic and municipal use. TDS is a comprehensive measure of all salts in groundwater, and is therefore used as the indicator parameter for salts in this SNMP. Tracking individual salts such as sodium, magnesium, or calcium is less informative for salt management because these solutes are subject to cationic exchange, which may decrease concentrations of one solute while increasing another. The relative proportions of calcium, sodium or magnesium may change from geochemical reactions, but the TDS stays relatively constant and is therefore a more robust measure of salts in groundwater. Limitations to TDS measurement accuracy can make comparison of TDS analyzed by different methods difficult. However, the consistent application of a single method employed for analysis of District samples makes TDS the best overall indicator of salt in groundwater.

Dissolved solids in groundwater are related to the interaction of water with the atmosphere, soil, and rock, as well as the quality of water entering the aquifer by managed and incidental recharge. Although not considered a "primary" contaminant associated with health effects, it is used as an indication of the aesthetic characteristic of drinking water. TDS in groundwater can be artificially elevated due to runoff, soil leaching, land use, recharge with high salinity water, or intrusion of saltwater from in the tidal reaches of creeks near the bay.

The Division of Drinking Water (DDW)[12] has adopted a SMCL, 500 mg/L for TDS, which is also the RWQCB's Basin Plan Objective. SMCLs address aesthetic issues related to taste, odor, or appearance of the water and are not related to health effects. The District compares concentrations of TDS to both the "recommended" and an "upper" SMCL as identified by DDW.

Table 2–6 summarizes 2012 data for TDS in the principal aquifer zones of the Santa Clara Groundwater Subbasin. Thirty-two of 101 wells (31.7%) tested in the Santa Clara Plain were found to contain TDS in excess of the "recommended" SMCL of 500 mg/L. When wells in the zone of saline intrusion are excluded from the count of wells with TDS in excess of the SMCL (4 wells), there are 27 of 96 wells (28%) with TDS greater than 500 mg/L. Two of the wells tested in the Santa Clara Plain principal aquifer exceeded the "upper" SMCL of 1,000 mg/L for TDS. Both wells with TDS greater than 1,000 mg/L are deep monitoring wells located in the same

[11] Additional information is available in the District's most recent annual groundwater report at http://www.valleywater.org/services/Groundwater.aspx.
[12] In July, 2014, the California Department of Public Health Division of Drinking Water was reorganized into the State Water Resources Control Board.

cluster in Palo Alto, where marine sediments contribute to elevated TDS (Metzger and Fio, 1997).

In the Coyote Valley, 2 of 20 wells (10%) tested contained TDS above the “recommended” SMCL. None of the wells tested in Coyote Valley exceeded the “upper” SMCL of 1,000 mg/L for TDS.

Table 12 – 2012 TDS Testing Results

Constituent	Units	SMCL[1]	Santa Clara Plain[2]		Coyote Valley	
			Median	Range	Median	Range
Total Dissolved Solids	mg/L	500 (1000)	395	174 – 2,520[3]	358	236 – 630

1. The lower recommended limit is listed and the upper limit is shown in parentheses. Source: 2012 Annual Groundwater Report.
2. Santa Clara Plain results are for the principal aquifer zone (wells with a total depth greater than 150 feet).
3. The well with elevated TDS is screened at 780 feet below ground in a zone of marine sediments (Metzger and Fio, 1997).

2.5.2 Nitrate

Nitrate is regulated with a MCL due to acute health effects (methemoglobinemia)[13] in infants exposed to elevated nitrate levels. Elevated nitrate concentrations have been an ongoing groundwater quality challenge in the Llagas Groundwater Subbasin in the southern part of the County.[14] Groundwater in the Santa Clara Plain and the Coyote Valley is generally well below the nitrate MCL with a few localized exceptions. The primary sources of nitrate added to the Santa Clara Plain include irrigated groundwater, sewer system exfiltration, and recycled water. The area overlying the Santa Clara Plain consists mostly of urban and suburban development. Almost all areas are served by municipal wastewater systems, and the use of individual septic systems is limited to the southern end of the Almaden Valley. While once prevalent, today only a few pockets of agricultural land remain in the Santa Clara Plain. Moderately elevated nitrate in the western portion of the Santa Clara Plain is likely due to past agricultural legacy land uses. Land use in the northern portion of the Coyote Valley is predominantly agricultural, and the southern portion contains both agricultural land use and residential development. Septic systems are common in much of the Coyote Valley because no municipal wastewater collection system exists. The primary sources of nitrate are agricultural fertilizers and septic tank leach fields (SCVWD, 1994).

Table 2–7 summarizes 2012 data for nitrate and other nitrogen constituents in the principal aquifer zones of the Santa Clara Plain and the Coyote Valley. One of 210 wells tested located in the Santa Clara Plain was found to contain nitrate in excess of the MCL (less than 1%). In Coyote Valley, 6 of 39 wells (15%) tested contained nitrate above the MCL.

The Basin Plan Agricultural Objective of 5 mg/L for nitrate + nitrite (as N) was also exceeded in several wells in the Santa Clara Groundwater Subbasin. Thirty seven of 210 wells (18%) in the

[13] Methemoglobinemia is the presence of methemoglobin in the blood due to conversion of part of the hemoglobin to this inactive form, and can be induced from consumption of excessive concentrations of nitrate in food or water.
[14] See the Llagas Subbasin SNMP for further details on nitrate and TDS in the Llagas Subbasin.

principal aquifer zone of the Santa Clara Plain exceeded the agricultural objective, and 22 wells (56%) in the Coyote Valley exceeded the agricultural objective for nitrate + nitrite.[15]

Table 13 – 2012 Nitrogen Constituent Testing Results

Constituent	Units	MCL	Santa Clara Plain[1]		Coyote Valley	
			Median	Range	Median	Range
Nitrate (as NO_3)	mg/L[2]	45	12.4	ND[3] – 45.6	10.6	ND – 58

1. Santa Clara Plain results are for the principal aquifer zone or wells with a total depth greater than 150 feet. Source: Santa Clara Valley Water District 2010 Groundwater Quality Report.
2. mg/L = milligrams per liter (parts per million).
3. ND = Not detected at testing limit.

2.5.3 Trends in TDS and Nitrate

Trends in TDS and nitrate were evaluated from 1998 to 2012, using the non-parametric, non–-seasonal Mann-Kendall trend test. This procedure was chosen due to its ability to handle non-detect data and ease of use. All trend tests were evaluated at the 95% confidence level (alpha = 0.05). Trends were tested at all wells having a minimum of 5 data points over the fifteen-year period. Table 14 provides a summary of nitrate and TDS trend results by area and aquifer zone. Maps showing the spatial distribution of TDS and nitrate concentration trends are shown in Figures 13 and 14.

Table 14 – 15-year TDS and Nitrate Concentration Trend Analysis Results (1998-2012)

Study Area Category	# wells w/ upward trend	# wells w/ downward trend	# wells w/ no trend	Total	Range of Change: upward rate of change (mg/L/yr)	Range of Change: downward rate (mg/L/yr)
Total Dissolved Solids						
Santa Clara Plain – principal zone	3	6	138	147	7.6–9.9	4.9–22.4
Santa Clara Plain – shallow zone	2	5	14	21	27.1–104.9	2.5–56.4
Coyote Valley	2	0	15	17	5.4–18	–
Total	**7**	**11**	**167**	**185**	**–**	**–**
Nitrate as NO_3						
Santa Clara Plain – principal zone	10	48	171	229	0.2 – 0.7	0.03 – 1.68
Santa Clara Plain – shallow zone	1	2	18	21	0.51	1.05 – 1.63

[15] Agricultural objective evaluated against nitrate data only, which are more abundant. If nitrate concentration exceeded agricultural objective, it was assumed that an analysis for nitrate + nitrate would also show exceedance of the agricultural objective.

Coyote Valley	2	8	18	28	1.07 – 1.15	0.04 – 1.44
Total	**13**	**58**	**207**	**278**	**--**	**--**

2.5.4 TDS Trends in Monitoring Wells, for 1998–2012

In the Santa Clara Plain shallow aquifer, TDS trends were tested on 21 wells, with upward trends detected in 2 wells, downward trends in 5 wells, and no trend in 14 wells (67%).

TDS trends were tested for 147 Santa Clara Plain principal aquifer wells. Upward trends were detected in 3 wells and downward trends were found in 6 wells. No trend was detected in the remaining 138 wells (94%). In the Santa Clara Groundwater Subbasin, wells having a downward trend in TDS are primarily located along or near Coyote Creek.

In the Coyote Valley, TDS was evaluated on 17 wells for 1998–2012. No trend was detected in 15 wells (88%) and an upward trend was detected in 2 wells (12%).

2.5.5 Nitrate Trends in Monitoring Wells, for 1998–2012

Nitrate trends were tested at 21 wells in the Santa Clara Plain shallow aquifer. An upward trend was detected in 1 well and downward trends were found in 2 wells, while no trends were detected in the remaining 18 wells (86%).

In the Santa Clara Plain principal aquifer, trends were tested for 147 wells, with an upward trend found in 3 wells and downward trend in 6 wells, and the remaining 138 wells displayed no trend (94%).

In the Coyote Valley, nitrate trends were tested on 28 wells. An upward trend was indicated in 2 wells and a downward trend in 8 wells, with 18 wells showing no trend (64%).

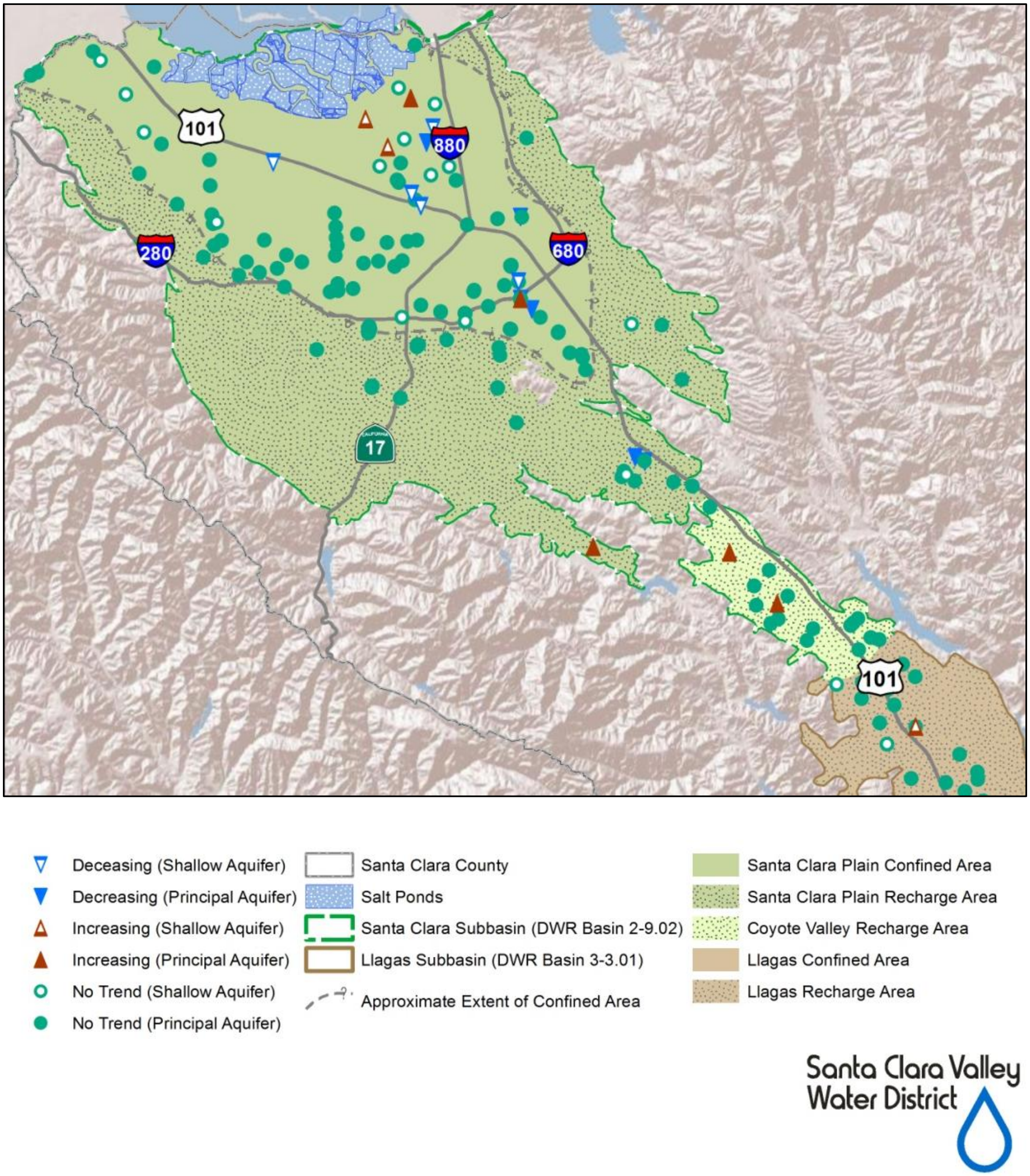


Figure 13 – 15-year TDS Trends in the Santa Clara Groundwater Subbasin (1998-2012)

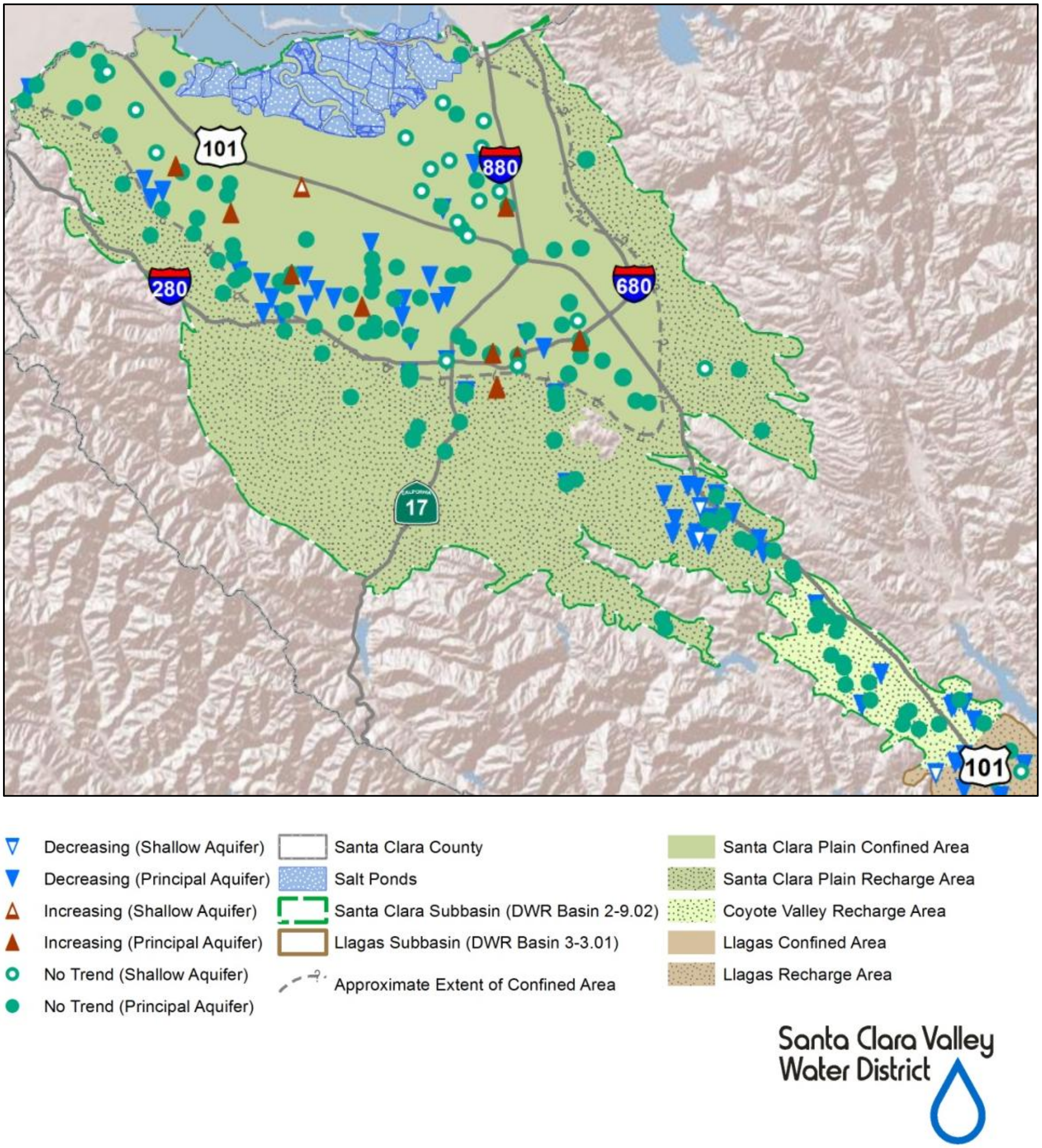


Figure 14 – 15-year Nitrate as NO3 Trends in the Santa Clara Groundwater Subbasin (1998-2012)

CHAPTER 3: ESTIMATING CURRENT AND FUTURE SALT AND NUTRIENT LOADING AND ASSIMILATIVE CAPACITY

The SWRCB Recycled Water Policy specifies that SNMPs include S/N source identification, basin/sub-basin assimilative capacity and loading estimates, and the fate and transport of salts and nutrients. This chapter summarizes the attributes of S/N loading, and current and future assimilative capacity.

3.1 Sources of Salts and Nutrients

Salts and nutrients are introduced to the subbasin by “wet loading” and “dry loading”. Wet loading includes the introduction of dissolved salts and nutrients through recharge from all sources of water, including rainfall, stream losses, irrigation, conveyance losses, drainage losses, basin inflow, mountain front recharge, and managed aquifer recharge. Dry loading includes dry fertilizer and soil amendments, and atmospheric deposition of particulate nitrogen, primarily from vehicle emissions. All known sources of salts and nutrients were reviewed and grouped to generate a comprehensive list of sources, summarized in Table 15. Avenues by which salts and nutrients are removed from the groundwater subbasin are also listed in Table 15.

Table 15 – Sources and Removal of Salts and Nutrients in the Santa Clara Groundwater Subbasin

Wet Sources	**Dry Sources**
Rainfall	Fertilizer
Basin In-flow and Saline Intrusion	Soil Amendments
Mountain Front Recharge	Atmospheric Deposition
Managed Recharge – Streams	
Managed Recharge – Ponds	**Removal**
Irrigation – Landscape/Municipal Supplies	Groundwater Pumping
Irrigation – Landscape/Recycled Water	Gaining Reaches of Streams
Irrigation – Landscape/Local Supply Wells	Basin Outflow
Irrigation – Agriculture	Sewer Line and Storm Drain Infiltration
Conveyance Losses – Pipeline Leaks	
Drainage Losses – Septic Tank Leach Fields	
Drainage Losses – Sewer Line Losses	
Drainage Losses – Storm Drain Losses	

Figure 15 demonstrates the relationship between the S/N loading sources in Table 15 and groundwater.

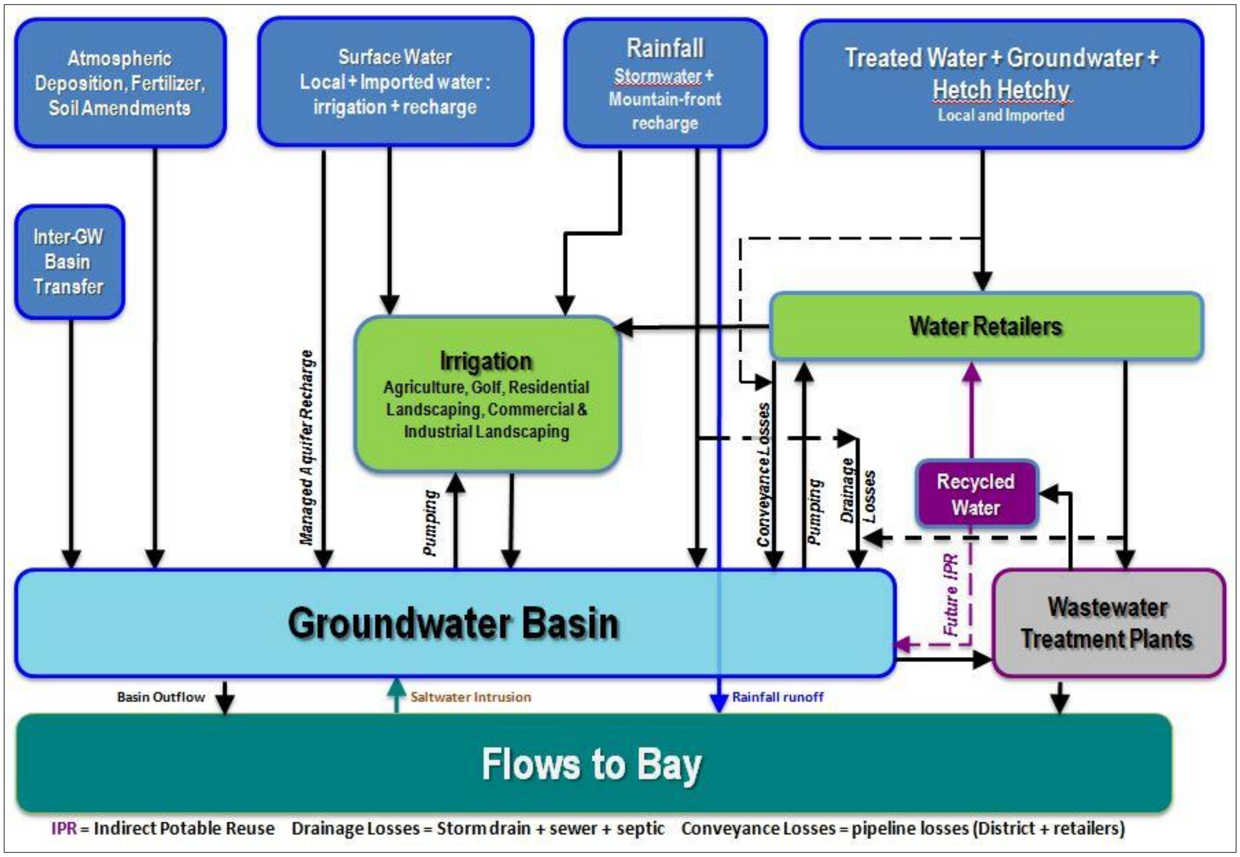


Figure 15 – Relationship of Salt and Nutrient Sources to Groundwater

3.2 Fate and Transport of Salts and Nutrients

Solutes (dissolved minerals) in irrigation water and dissolved from fertilizer and soil amendments may undergo physical and biological processes that affect their concentration and rate of migration. These processes are known as "fate and transport" processes, and contribute to removal of salt and nitrate as water percolates through the unsaturated zone to groundwater. Nitrate is prone to transformation and translocation by plants and microbes and may undergo volatilization, ammonification, nitrification and denitrification, adsorption or desorption, and fixation (Canter, 1997). Consequently, only a portion of the nitrate originally present in irrigation water or applied fertilizer will arrive at the water table and impact groundwater quality. The occurrence and rates of these processes depend on geochemical conditions such as the presence of soil organic matter or dissolved oxygen, soil moisture content, and temperature, all of which are highly variable. Rather than attempt to represent the geographic and seasonal variation in nitrate transformation processes, this SNMP estimates the fate and transport of salts and nitrates with a universal value that approximates the degree to which salts and nitrate leach to groundwater.

Mineral cations and anions excluding nitrate may also be involved in sorption and desorption and cationic exchange processes. A conservative assumption is made that salts in the

unsaturated zone have attained steady-state, i.e., any salts added to the surface will produce an equivalent addition of salts to the water table. Uptake of salts in crops and other vegetation is considered to be negligible, but a salt uptake value is assigned to turf (see below). By contrast, nitrate can undergo substantial root uptake, volatilization, and denitrification. Therefore, attenuation factors are used to estimate nitrate loading to groundwater. To estimate an appropriate attenuation factor for nitrate, we reviewed the range of values reported in the literature and other SNMPs and settled upon 50% crop uptake, 15% denitrification and volatilization, and 35% leaching to groundwater. A few of the literature studies and agency reports reviewed are summarized here:

- The Santa Rosa Plain draft SNMP (RMC, July, 2012) uses 25% applied nitrogen as leachable, 10% is off-gassed, and the balance is "used". No technical citations are provided.

- The District Llagas Nitrate Source Area Identification Study (1994) used 30% as the leaching factor for a typical crop of strawberries.

- Malone et al., 2007, measured 29% of total applied nitrogen leaching to groundwater for fertilization of corn and soybeans.

- Reports indicate NO_3-N losses from crops amounting to 24 to 55% of the N applied at recommended rates. The apparent crop uptake of applied N is on the order of 40 to 80%, depending on the timing of fertilizer applications, crop type, irrigation management, and other factors (WDOE, 2000).

- Typical N uptake efficiencies of major agronomic crops range from 30 to 70% (WDOE, 2000).

- Observed range of nitrogen volatilization in applied fertilizer was 2 to 50% N-emissions for soil pH > 7 and 0 to 25% emissions for soil pH < 7. If the N source is mixed into an acid soil, the emissions are usually greatly reduced (0 to 4% lost) (Meisinger and Randall, 1991).

Selecting a leaching factor of 35% for nitrate dissolved from crop fertilizer and in irrigated water may overestimate the degree of nitrate leaching to groundwater in some settings, while underestimating it in others. Underestimation can occur where double-cropping or macropore flow through root channels occurs (Sidle and Kardos, 1979), and from underestimating the amount of post-harvest leaching due to lack of over-winter cover crops (McCracken et al., 1994).

Fertilizer applied to lawns has a considerably higher degree of nitrate attenuation due to the accumulation of thatch in the turf root zone. The following assumptions are made for nitrogen fertilizer applied to lawns:

- All applied nitrogen (N) is converted to nitrate.

- Total N application rate is 3.5 pounds per 1,000 ft^2 (~150 lbs N/acre) in 50% of the lawns per year (UCD, 2002).

- 80% of applied nitrogen is taken up by turf.

- 15% of applied nitrogen is volatilized.

- 5% of applied nitrogen is converted to nitrate and leached to groundwater (based on Kopp and Guillard, 2005).[16]

To estimate salt loading from lawn fertilizer, the following assumptions were made:

- Total fertilizer applied was taken as applied nitrogen divided by 33% to estimate salt loading.
- Total salt loading from fertilizer application to turf is 161 lbs/acre, using the ratio salt leaching to N-uptake (111%) from 11 varieties of hay (NCCE, 2008).

In the managed aquifer recharge setting, nitrate attenuation is assumed to be greater for in-stream recharge than for percolation ponds due to the greater presence of natural organic matter in stream sediments. Presence of readily available organic carbon and absence of oxygen are prerequisites for microbial denitrification of nitrate in recharge water (Canter, 1997). Percolation ponds are designed and maintained to optimize percolation rates and have less organic carbon and residence time in an anaerobic sediment zone than occurs in natural streams. Nitrate attenuation was assigned as 80% to in-stream recharge and 50% to percolation ponds (i.e., the amount of nitrate leached to groundwater is 20% and 50%, respectively).

A summary of the nitrate attenuation factors assigned for the loading analysis in this SNMP is provided in Table 16.

3.3 Methodology for Estimating Salt and Nutrient Loading and Removal

The approach for estimating S/N loading from wet sources involves obtaining measurements or estimates of the volumes of water in each wet loading category, and the S/N content of each wet source. The water quality parameters used to represent all salts and nutrients are total dissolved solids (TDS)[17] and nitrate (NO_3). The total annual loading is taken as the product of the estimated annual volume and average annual concentration of TDS or nitrate, and for nitrate, an attenuation factor:

Volume/year $\times$ Concentration $\times$ Attenuation Factor = Mass Loading/year

The attenuation factor represents the degree to which the nitrate concentration is reduced due to denitrification or other processes. For example, if 50% of nitrate is taken up by roots, and 15% is converted from nitrate to nitrogen gas by denitrification, then 35% of nitrate concentration leaches to groundwater, and the attenuation factor is 65%. Table 16 lists the nitrate attenuation factors assigned to each loading category. When groundwater is removed or leaves the basin, the nitrate in that groundwater is removed, i.e., there is no attenuation factor applied to groundwater removal.

Dissolved salts, represented as TDS, are considered conservative solutes because their concentrations are not substantially attenuated by processes such as root uptake, geochemical

[16] The UCD 2012 nitrate study recommends using 10 kg N/hectare leached to groundwater (39.5 lbs NO_3/acre). Using 3.5 lbs/1,000 ft² and 5% leaching (the figures shown above) produces an estimate of 34 lbs/acre NO_3 /year for fertilized lawns.

[17] Total Dissolved Solids is commonly measured as Total Filterable Residue by Standard Method 2540 or EPA Method 160.1. In some instances, where TDS measurements are not available but specific conductance has been measured, an estimated value of TDS is used based on the basin-specific conversion factor from specific conductance to TDS.

conversion, sorption, or microbial processes. For most loading categories, TDS was assigned an attenuation factor of zero. For fertilizer applied to turf however, a larger amount of root uptake is assumed, as explained in Section 3.2. Because nitrate is a component of TDS, TDS loading from irrigation was adjusted to account for root uptake and denitrification of nitrate.

Table 16 – Nitrate Attenuation Factor Assumptions by Loading Category*

Loading Category	Root Uptake	Denitrification/ Volatilization	Leached to Groundwater
Crop Fertilizer	50%	15%	35%
Lawn Fertilizer (Dry)	80%	15%	5%
Irrigated Water	50%	15%	35%
Rainfall	50%	15%	35%
Conveyance Losses	0%	15%	85%
Mountain Front Recharge	0%	15%	85%
Drainage Losses	0%	15%	85%
Recycled Water	50%	15%	35%
Atmospheric Deposition	80%	15%	5%
Managed Recharge – Ponds	0%	50%	50%
Managed Recharge – Streams	0%	80%	20%

***The basis for these assumptions is detailed in Section 3.2**

3.3.1 Wet Loading Categories

Volume estimates for wet loading categories were obtained primarily from the District's groundwater flow models for the Santa Clara Groundwater Subbasin, i.e., the Santa Clara Plain model ("SCPMOD"), and the Coyote Valley Model ("CVMOD"), and adjusted as described below for the 2001-2010 baseline period. The water balances for each of these subareas of the Santa Clara Subbasin are described in Section 2.1.4 (see Tables 7 and 10).

3.3.1.1 Rainfall Recharge

Rainfall contains only trace amounts of solutes and is allocated among three pathways relevant to the overall salt balance: runoff, infiltration with subsequent evapotranspiration, and infiltration with deep percolation. Only the water involved in deep percolation is added to groundwater, however, the salt and nitrate in rainfall remains in the soil profile. This salt will ultimately migrate to groundwater, whereas the nitrate added to soil from rainfall will be attenuated by root uptake and denitrification, with 35% assumed to migrate to groundwater.

The volume of rainfall that ends up as percolation, or infiltration with subsequent evapotranspiration, cannot be measured directly and must therefore be estimated. Many factors determine the volume of rainfall that infiltrates such as soil type, vegetative cover, slope, etc. Assessing the variability of rainfall infiltration by accounting for all these factors is a time-consuming undertaking that is beyond the scope of this analysis. Rainfall contributes only a minor amount of salt and nitrate compared to other loading categories. Total estimated volumes of rainfall were obtained from the Santa Clara Plain and the Coyote Valley groundwater flow models. Estimated rainfall infiltration was taken as 22% of total rainfall, which is the 10-year median rainfall net of evaporation divided by 10-year median of total rainfall for the Los Gatos rain gauge station. Deep percolation was estimated using formulas applied to seven rainfall zones in the Santa Clara Plain model, and four rainfall zones in the Coyote Valley Model. Deep

percolation estimates range from 10 to 15% and are determined for each model cell based on empirical formulae applied to rainfall data from local rainfall gages. The estimated volumes of rainfall contributing salt and nitrate to groundwater through deep percolation and infiltration followed by evapotranspiration are 13,300 AF/yr in the Santa Clara Plain, and 5,000 AF/yr in the Coyote Valley. Appendix 4 provides details for the rainfall infiltration volume estimates.

Rainfall quality is highly variable. For example, TDS in rainfall measured at the US Geological Survey offices in Menlo Park ranged from 8.2 to 38 mg/L (Hem, 1985). The estimates of salt and nitrate loading from rainfall, 10 mg/L and 1.2 mg/L, respectively, were selected from literature values as representative concentrations to be applied uniformly to rainfall infiltration in both the Santa Clara Plain and Coyote Valley subareas (SWRCB, 2010; NADP, 2012).

The total estimated salt and nitrate loading from rainfall is given in Table 17. Calculation details are provided in Appendix 4.

Table 17 – Estimated Salt and Nitrate Loading from Rainfall Infiltration

	Santa Clara Plain	Coyote Valley	Total
Rainfall Infiltration, AF/yr	13,300	5,000	18,300
Salt Loading as TDS, tons/yr	180	29.9	210
Nitrate as NO_3 Loading, tons/yr	8.2	1.4	9.6

3.3.1.2 Mountain-front Recharge

Mountain-front recharge (MFR) accounts for subsurface inflows from bedrock in the hills surrounding the Santa Clara Plain, and for inflow from uncontrolled reaches of streams. The source for the MFR estimates is the Santa Clara Plain groundwater flow model (SCPMOD). For the Santa Clara Plain, a rainfall-runoff approach was used to estimate MFR (CH2M HILL, 1992), as shown in Table 18.

The SCPMOD model distributes MFR for each mountain range across all model cells bordering the mountain range, in proportion to the length of cell perpendicular to the mountains, as shown in Figure 16. For SCPMOD, MFR is treated as a groundwater gain (11,855 AF/yr), regardless of weather conditions.

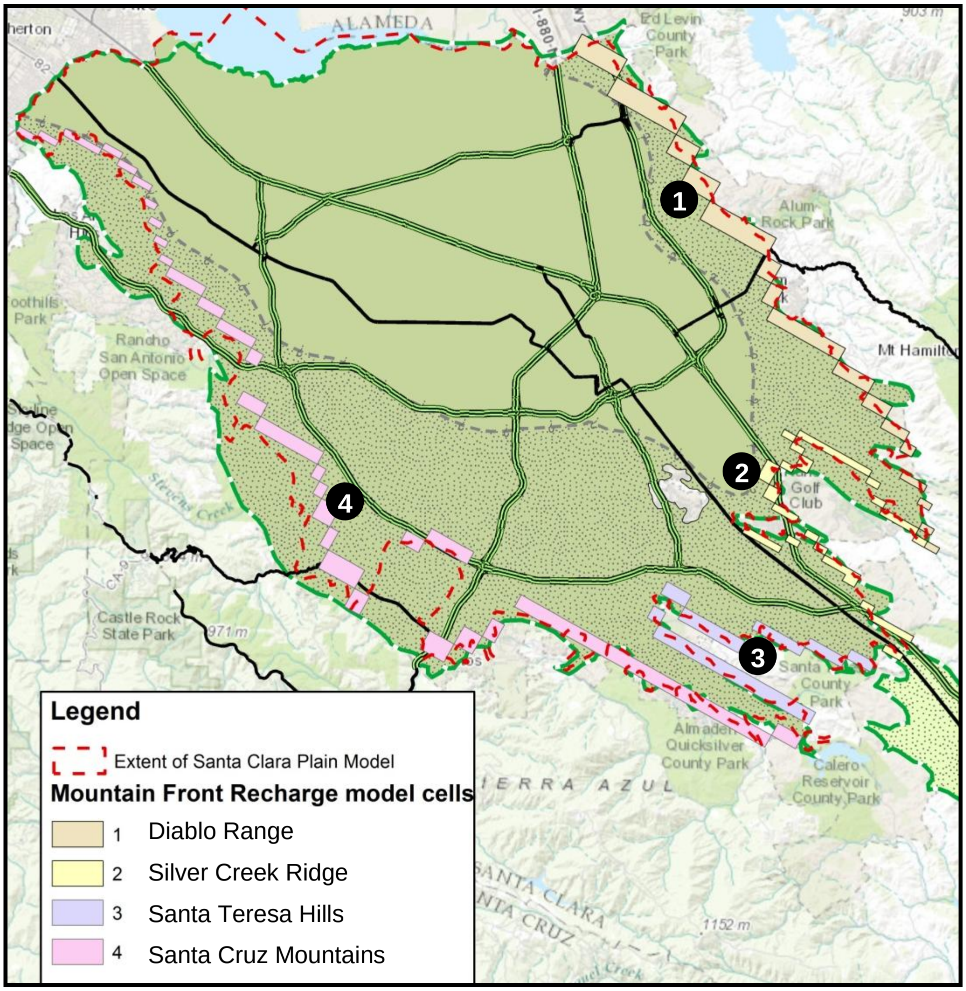


Figure 16 – Mountain-front Recharge Zones in Santa Clara Plain Groundwater Flow Model

Table 18- Santa Clara Plain Model Mountain-Front Recharge Estimates

Mountain-front recharge		Estimated recharge (inches/yr)	Estimated recharge (AF/yr)
Diablo Range	❶	1	2,900
Silver Creek Ridge	❷	.5	300
Santa Teresa Hills	❸	1	400
Santa Cruz Mountains	❹	1	8,255
	Total		11,855

Recharge rates shown are for all years independent of hydrology.

MFR is considered negligible and is excluded in the Coyote Valley groundwater flow model. For SNMP, salt and nitrate loading from the minor amount of MFR is also excluded.

Salt and nitrate concentrations in groundwater in the bedrock hills are not monitored by the District. To estimate MFR water quality attributes, the values assigned to MFR are based on measured water quality in nearby streams and monitoring wells near the basin boundaries. The

volume-weighted average of the TDS assigned to the four MFR zones is 286 mg/L, and for nitrate as NO_3, 3.2 mg/L. The resulting loading estimates from MFR are listed in Table 19.

Table 19 – Estimated Salt and Nutrient Loading from Mountain-Front Recharge

Mountain-front recharge zone	Representative Creeks	Composite Creek & Groundwater TDS*	Composite Creek & Groundwater NO_3*
❶ Diablo Range	Penitencia Creek-Upper; Silver Creek, Flint Creek	366	2.4
❷ Silver Creek Ridge	Coyote Creek	301	3.7
❸ Santa Teresa Hills	Alamitos Creek	314	4.1
❹ Santa Cruz Mountains	Stevens Creek, Saratoga Creek	256	3.5

* Assumed creek/groundwater mix for composite values is 80/20.

	Santa Clara Plain	Coyote Valley	Total
MFR Volume, AF/yr	11,855	0	11,855
MFR Salt Loading, tons/yr	4,600	0	4,600
MFR Nitrate as NO_3 Loading, tons/yr	44	0	44

3.3.1.3 Basin Inflow and Saline Intrusion

As described in section 2.1.1 and Figure 1, groundwater from the Coyote Valley flows into the Santa Clara Plain area, which adds salt and nitrate. The Coyote Valley is bounded by bedrock on its eastern and western edges, and abuts the Llagas Groundwater Subbasin on its southern edge. The boundary between the Coyote Valley area and the Llagas Groundwater Subbasin is a topographic high that is considered a hydrologic divide. Accordingly, Coyote Valley does not have basin inflow from the Llagas Groundwater Subbasin.

The basin inflow to the Santa Clara Plain from the Coyote Valley (8,200 AF/yr) is estimated using the groundwater flow models. Estimated loading from basin inflow is provided in Table 20.

Table 20 – Estimated Salt and Nitrate Loading from Basin Inflow to the Santa Clara Plain

Volume, acre-feet/yr	Coyote Valley TDS, mg/L	Coyote Valley NO_3, mg/L	TDS loading to Santa Clara Plain, tons/yr	NO_3 loading to Santa Clara Plain, tons/yr
8,200	376	24.6	4,140	230

Groundwater in the northern end of the Santa Clara Groundwater Subbasin is prone to saline intrusion due to the incursion of saline water from the San Francisco Bay in the lower reaches of creeks. The extent of saline intrusion in the shallow aquifer is limited and located primarily above the confined aquifer, i.e., the principal aquifer is not impacted by saline intrusion from the San Francisco Bay. Figure 17 displays the extent of saline intrusion in the shallow aquifer defined as chloride concentrations of 100 mg/L or more.

Saline intrusion is mapped from data obtained from annual groundwater sampling events. Net decrease in the chloride content is measured in wells monitored continuously over many years. The current mapped extent of saline intrusion is considerably smaller than the extent originally mapped in 1980. The decrease in the area impacted by saline intrusion may be due to a combination of reduced pumping near the bay, limited pumping in the shallow zone, and salt removal in gaining reaches of streams. Saline intrusion is considered to be limited to the shallow aquifer along the tidal reaches of streams and close to the bay or salt evaporation ponds. As detailed in Section 3.3, the Santa Clara Plain was not subdivided for analysis of S/N loading, therefore the salt load from saline intrusion was not included as a salt loading term because the areal extent of saline intrusion is limited and decreasing. The impact of saline intrusion on groundwater quality is incorporated into the determination of assimilative capacity (see Section 3.3).

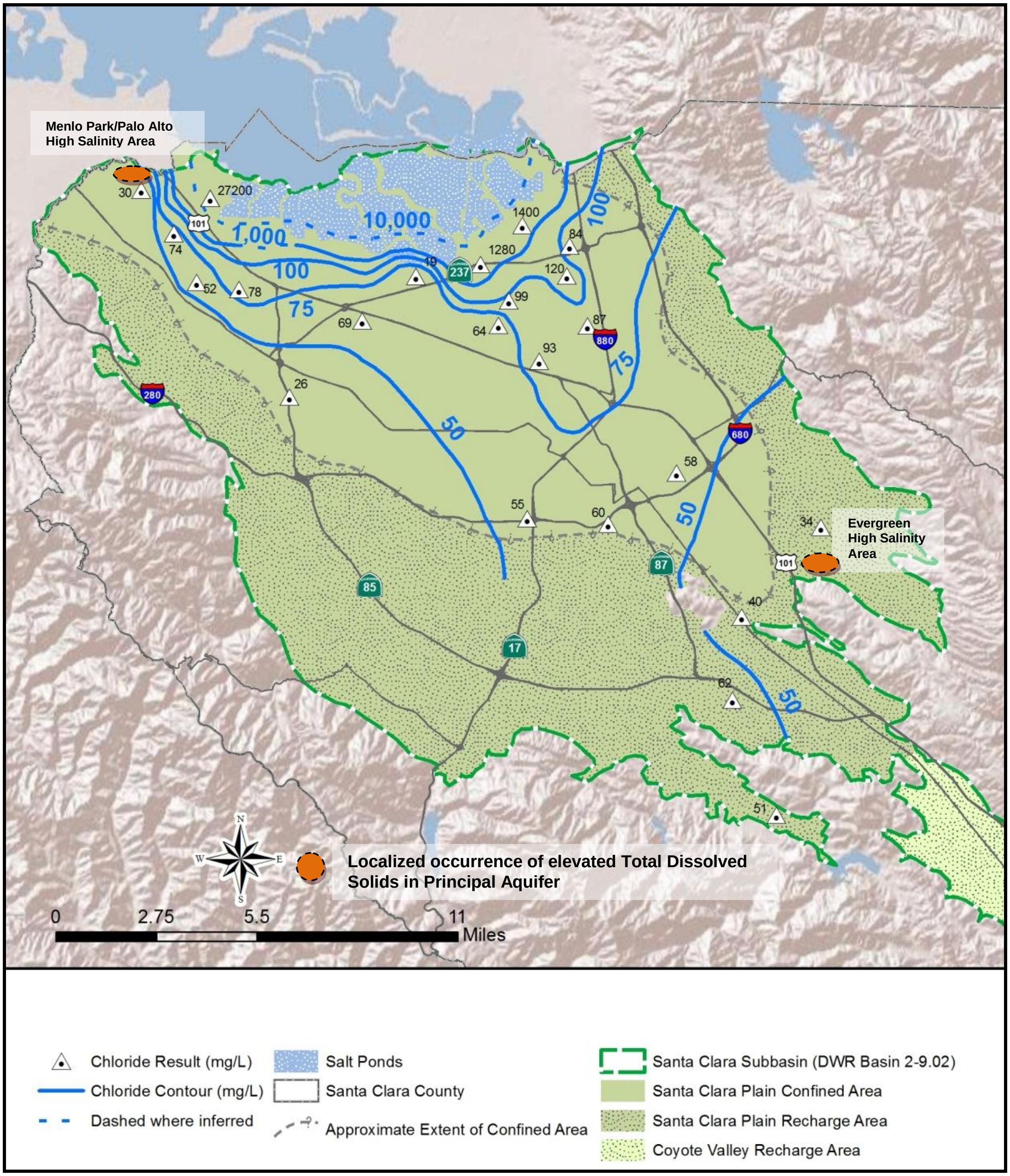


Figure 17 – Zone of Saline Intrusion into the Shallow Aquifer, Santa Clara Plain

Chloride contours: SCVWD, 2013; SE salinity zone: SCVWD, 1989; NW salinity zone: Metzger and Fio, 1997; see Section 3.4.1.

3.3.1.4 Managed Recharge in Streams

The District's recharge operations sustain groundwater supplies in the Santa Clara Groundwater Subbasin by percolating imported water and surface water from local reservoirs. Recharge operations include managed recharge in streams, profiled in this section, and managed recharge in percolation ponds discussed in the next section. The quality of water used for managed aquifer recharge in streams is better than ambient groundwater with respect to TDS and nitrate. Managed recharge in streams results in the addition of TDS and nitrate to the aquifers.

The volume of water in managed recharge in streams is tracked by stream gauging, by tracking the amount of water released at turnouts, and by periodic surface water balance. Managed recharge involves releasing water from upstream reservoirs or pipeline turnouts during summer and fall months. Natural recharge from rainfall runoff occurs during the winter and spring. The total volumes are given as ten-year medians in Table 21.

The quality of water used in managed recharge in streams varies depending on water source (reservoirs or imported water), time of year, discharges, and runoff. Managed recharge in streams involve local reservoir and imported water sources, so blended water quality was calculated from each source. The overall range, median, and volume-weighted average (VWA) concentration values for TDS and nitrate of water used in managed recharge in streams are given in Table 21.

While streams are used for managed recharge, they are natural features that host aquatic ecosystems. The sediments through which groundwater recharge occurs are rich in organic matter, which can create an anoxic environment conducive to denitrification. As shown in Table 16, a higher nitrate attenuation factor is assumed for streams, so only 20% of nitrate in stream water is assumed to migrate to groundwater.

Table 21 – Estimated 10-year Median Salt and Nitrate Loading from Managed Recharge in Streams

	Santa Clara Plain	Coyote Valley	Total
Stream Recharge Volume	36,680 AF/yr	14,470 AF/yr	51,150 AF/yr
TDS Concentration Statistics	Range = 227 – 460 mg/L Median = 286 mg/L VWA = 135 mg/L	Range = 186 – 320 mg/L Median = 238 mg/L VWA = 248 mg/L	
Nitrate as NO_3 Concentration Statistics	Range = .84 – 7.2 mg/L Median = 1.22 mg/L VWA = .38 mg/L	Range = .5 – 1.9 mg/L Median = .84 mg/L VWA = .96 mg/L	
Salt Loading as TDS	7,960 tons/year	4,680 tons/year	12,640. tons/year
Nitrate as NO_3 Loading	19 tons/year	3.3 tons/year	22.4 tons/year

VWA = volume-weighted average Volumes are 10-year medians of 2001-2010.

3.3.1.5 Managed Recharge in Percolation Ponds

Managed recharge in percolations ponds follows the same pattern as recharge in streams, except a greater degree of control is exerted over source water quality, as most facilities exclude runoff. Percolation ponds are also maintained to remove accumulated sediment. In addition, percolation ponds create aquatic ecosystems in which algae and plants contribute organic matter, enhancing denitrification. As listed in Table 16, percolation ponds are assigned an assumed nitrate attenuation factor of 50%. Because percolation rates far exceed evaporation rates by 20 to 110 times (summer vs. winter), evaporative concentration of salts and nitrate are considered negligible. As water quality samples from ponds used for this analysis reflect both dry season and wet season conditions, an evaporation factor was not included.

The volume of water recharged through percolation ponds is measured by gauging pond depths and reading flow meters. Source water and pond water quality is also monitored by the District so the salt and nitrate loading can be estimated. Table 22 summarizes quantities, quality, and salt and nitrate loading from managed recharge in percolation ponds in the Santa Clara Plain. There are no percolation ponds in the Coyote Valley.

Table 22 – Estimated Salt and Nitrate Loading from Managed Recharge in Percolation Ponds

	Santa Clara Plain
Percolation Pond Recharge Volume	24,810 AF/yr
TDS Concentration Statistics	Range = 190 – 306 mg/L Median = 251 mg/L VWA = 497 mg/L
Nitrate as NO_3 Concentration Statistics	Range = .78 – 9.93 mg/L Median = .84 mg/L VWA = .96 mg/L
Salt Loading as TDS	16,760 tons/yr
Nitrate as NO_3 Loading	20.3 tons/yr

3.3.1.6 Agricultural Irrigation

Irrigation of landscaping and crops leads to the addition of salts to aquifers because most of the water is taken up by plants or evaporated. Root uptake of salts is minimal due to semi-permeable membranes in root hairs that regulate solutes. Most of the mineral salts in irrigation water are excluded, while half the nitrate is taken up by roots. Consequently, while only 20% of irrigated water may percolate through the unsaturated zone to groundwater, nearly all of the mineral salt present in irrigated water is assumed to remain in the soil profile and will ultimately migrate to groundwater. Because nitrate is a constituent of TDS, the TDS load from irrigation water was reduced by the amount of nitrate attenuation to account for root uptake and denitrification.

Nitrate in irrigated water is needed by plants and is taken up by their roots. Rates of root uptake of nitrate in irrigation water will vary depending upon crop types, soil types, soil moisture, and many other factors. For the purposes of this plan, a single factor, 50% root uptake, is applied

for nitrate in irrigated water, and 15% denitrification is assumed, so that 35% of nitrate in irrigated water is presumed to migrate to groundwater.

The volume of irrigated water is obtained from records of pumping which is classified as agricultural. A separate water rate for agricultural pumping facilitates an inventory of pumping for agricultural irrigation. Smaller agricultural water use, such as irrigating home orchards and gardens, is included in the assessment of outdoor irrigation loading from domestic wells and municipal water (Section 3.3.1.7).

In the Santa Clara Groundwater Subbasin, agricultural irrigation is concentrated in the Coyote Valley and supplied by locally pumped groundwater. The water quality for agricultural irrigation is assumed to be the volume-weighted average salt and nitrate concentration. Similarly, the minor amount of groundwater pumped from the wells classified as agricultural is assigned the volume-weighted average salt and nitrate concentration. Table 23 summarizes the volumes and quality of water used in irrigated agriculture in the Santa Clara Plain and the Coyote Valley and the resulting salt and nitrate loading.

Table 23 – Estimated Salt and Nitrate Loading from Agricultural Irrigation

	Santa Clara Plain	Coyote Valley	Total
Irrigation Water Volume, AF/yr*	660 AF/yr	4,300 AF/yr	4,960 AF/yr
Volume-weighted TDS Concentration *	425 mg/L	375 mg/L	
Volume Weighted Nitrate as NO_3 Concentration*	11 mg/L	25 mg/L	
Salt Loading as TDS, tons/yr*	320 tons	2,070 tons	2,390 tons
Nitrate as NO_3 Loading, tons/yr*	3 tons	49 tons	52 tons

* Ten-year median

3.3.1.7 Landscape Irrigation – Municipal and Domestic Water Sources

Outdoor water use for landscape irrigation comprises a large portion of water demand. A large amount of salt is included with this water use. Most of the water used for outdoor irrigation of residences, businesses, corporate, and municipal landscaping, is used by plants or evaporated. The majority of the salt carried by irrigation water is retained in the soil profile and ultimately leaches to groundwater. Nitrate in irrigation water is consumed by plants and subject to denitrification. For irrigated turf the nitrate attenuation factors in Table 16 apply i.e., 50% is taken up by roots, while 15% is lost to denitrification.

Water retailers serve a wide range of water types, each having its own nitrate and TDS concentrations that vary from year to year. For example, a city may serve a combination of treated surface water, groundwater, and water from the Hetch-Hetchy system. To assess the salt and nitrate loading from landscape irrigation, each water retailer service area was broken out into sub-areas by water type and by areas located within the subbasin vs. outside the subbasin. Volumes of each type of water were determined for each sub-area, and the amount of indoor vs. outdoor use was estimated using figures provided in each water retailer's Urban Water Management Plan (UWMP). The water use categories distinguish single-family homes from multi-family homes, and amounts of water used in applications that are mostly indoor (industrial) to mostly outdoor uses (municipal/parks). Estimates of the indoor/outdoor water use split for each water use category were obtained from the City of Santa Clara's UWMP. Table 24

lists the indoor/outdoor splits used for all water retailers. The overall indoor/outdoor split for each retailer's in-basin water use depends on the breakdown of water use categories. The indoor/outdoor split for the entire Santa Clara Groundwater Subbasin is 55.5%/44.5%, i.e., 44.5% of residential water use is outdoors.

Table 24 – Indoor-Outdoor Water Use Estimates by Water Use Category

Indoor vs. Outdoor (Landscape) Water Use	Indoor	Outdoor
Single Family	50.5%	49.5%
Multi Family	76.4%	23.6%
Industrial	77.3%	22.7%
Commercial	60.8%	39.2%
Institutional	35.9%	64.1%
Municipal	26.7%	73.3%

Water quality data used to estimate salt and nitrate loading was obtained for each water type for each of the ten baseline years (2001–2010).[18] Groundwater quality was taken as the ten-year median value of all the active wells within each water retailer service area. Loading was then determined by multiplying the salt and nitrate concentrations with the in-basin outdoor use volumes for each water type, for each year. The resulting median salt and nitrate loading estimates are summarized in Table 25.

The majority of salt and nitrate loading summarized in Table 24 is from outdoor water use. Landscape irrigation is also supplied by sources such as domestic wells and wells that supply cemeteries, golf courses, and other water users. These sources make up less than 1% of outdoor irrigation in the Santa Clara Plain, but in the Coyote Valley, where most of the residences are supplied by domestic wells, they comprise 87% of the non-agricultural outdoor irrigation.

Table 25 – Median Salt and Nitrate Loading from In-Basin Landscape Irrigation†

	Santa Clara Plain	Coyote Valley	Total
In-basin, Outdoor Irrigation Volume*	109,440 AF/yr	1,740 AF/yr	111,180 AF/yr
TDS Concentration**	284 mg/L	375 mg/L	
Nitrate as NO_3 Concentration**	2 mg/L	17 mg/L	
Salt Loading as TDS*	42,270 tons	840 tons	43,110 tons
Nitrate as NO_3 Loading*	322 tons	18 tons	340 tons

* Ten-year median
** Ten-year median of volume weighted averages for all water types.
† Includes residential outdoor irrigation supplied by water retailers, domestic well landscape irrigation, and non-retailer pumping for landscape irrigation uses (parks, golf courses, cemeteries, etc.).

[18] Water quality for SCVWD treated water and Hetch Hetchy water taken from retailer Consumer Confidence Reports and from District records.

3.3.1.8 Landscape Irrigation – Recycled Water

The three wastewater treatment plants operating in the Santa Clara Plain currently produce tertiary-treated recycled water used to irrigate parks, golf courses, street trees, and landscaping in corporate business parks, housing developments and industrial uses. Advanced treated recycled water is also produced at the Silicon Valley Advanced Water Purification Center. The advanced treated water is blended with tertiary treated recycled water from the South Bay Water Recycling system. Blending advanced treated recycled water with tertiary treated recycled water results in lower TDS and nitrate concentrations than current tertiary-treated recycled water.

In 2013, recycled water accounted for 5% of all water used in Santa Clara County. Locations of current and planned recycled water irrigation as of 2012 are shown in Figure 18. Recycled water used for irrigation contributes salt and nitrate to groundwater and has the potential to increase groundwater nitrate and TDS concentration because concentrations are higher in recycled water than in groundwater. The volume-weighted average TDS of recycled water from all three systems is 746 mg/L while the volume-weighted groundwater TDS concentration is 425 mg/L. Similarly, the volume weighted average nitrate (as NO_3) content in recycled water listed in Table 1 is 45.9 mg/L while the median groundwater nitrate concentration in the Santa Clara Plain is 10.8 mg/L.

Recycled water volumes and concentrations of TDS and nitrate were obtained from wastewater plant operators to estimate the total salt and nitrate loading. The nitrate attenuation factors, listed in Table 16, are the same as applied to irrigation (i.e., 50% root uptake, 15% denitrification, and 35% of nitrate leaches to groundwater).

Table 26 – Median Estimated Salt and Nitrate Loading from In-Basin Landscape Irrigation with Recycled Water

	Santa Clara Plain
In-basin, Outdoor Recycled Water Irrigation Volume*	6,640 AF/yr
TDS Recycled Water Concentration *	746 mg/L
Nitrate as NO_3 Recycled Water Concentration*	46 mg/L
Recycled Water Salt Loading as TDS*	6,725 tons/yr
Recycled Water Nitrate as NO_3 Loading*	141 tons/yr

* Ten-year median concentrations are volume weighted for all three recycled water producers. Recycled water is not used for irrigation in Coyote Valley.

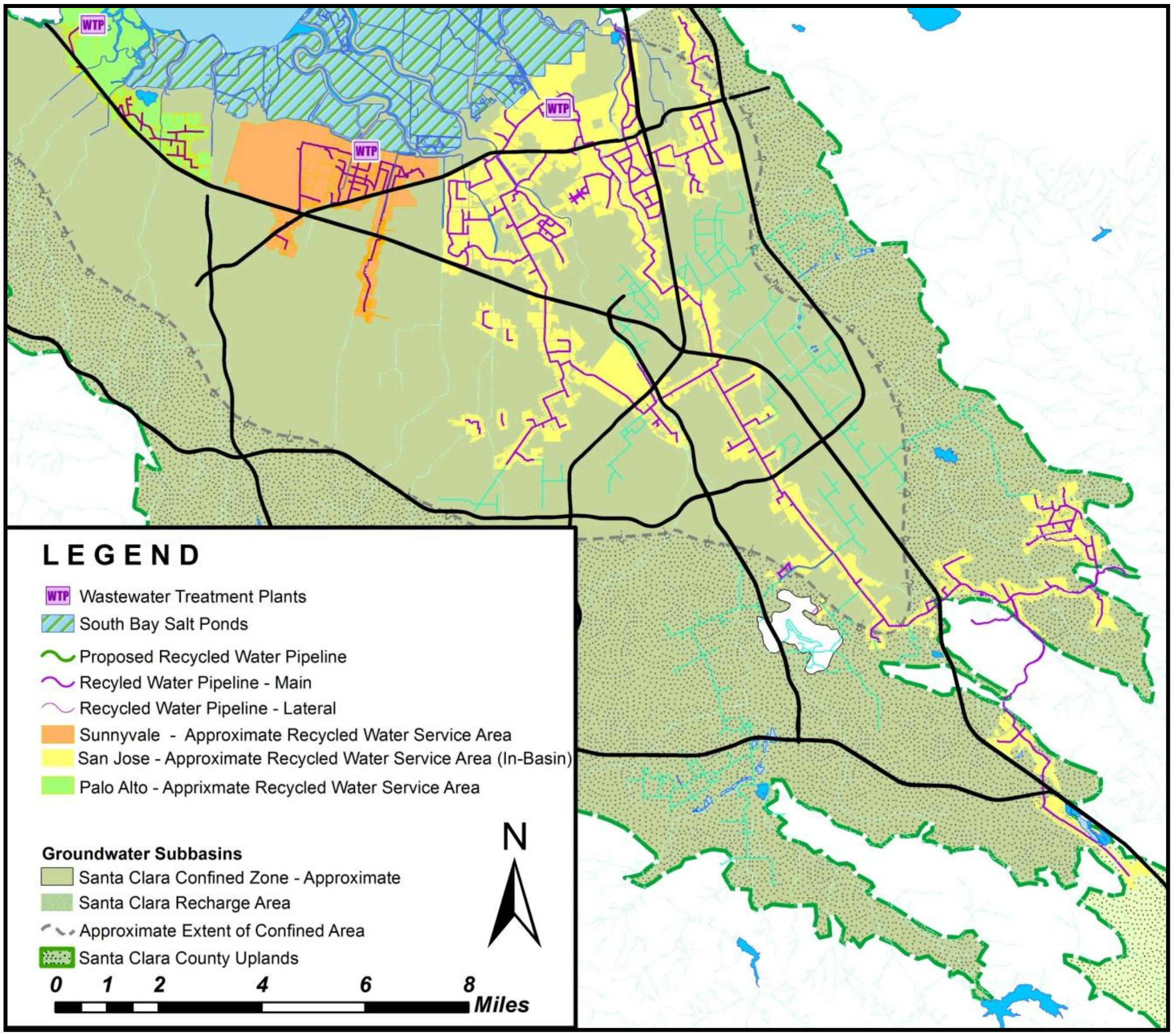


Figure 18 – Locations of Current and Proposed Recycled Water Irrigation as of 2012

3.3.1.9 Conveyance Losses

Losses from regional raw and treated water pipelines and losses from water utility local distribution networks are grouped together as conveyance losses. Conveyance losses occur below the root zone, so all the water moves to groundwater and contributes salt and nitrate to groundwater. Water lost from pipelines is treated drinking water, groundwater, or raw water en route to treatment plants, and contains salt and nitrate which is included in the overall salt balance.

An estimate of water utility distribution network loss rates was developed by taking the system losses reported by 9 water retailers as a percentage of total water supplied in the retailers Urban Water Management Plans. Based on data supplied by San Jose Water Company, we assumed half the system losses are “real” losses that result in salt and nitrate addition to groundwater, while the other half are losses attributable to hydrant testing, line flushing, and meter uncertainty. An assumed loss rate of 0.1% in regional raw water and treated water pipelines is based on the technical literature. District operators report that no losses are observed within the limits of measurement by flow meters.

The concentrations of TDS and nitrate in losses from District raw and treated water pipelines are similar and low, while the ten-year median of volume-weighted average TDS and nitrate concentrations for losses from retailer distribution systems, which include groundwater sources, are higher. Because losses occur below the root zone only denitrification plays a role in nitrate attenuation for which a 15% nitrate attenuation rate is assigned (see Table 16). Table 27 lists the volumes, concentrations, and mass of salt and nitrate contributed by conveyance losses.

There are no treated water pipelines in the Coyote Valley, and only a small area of residential development connected to the City of Morgan Hill water, so the volume of conveyance losses in the Coyote Valley is negligible.

Table 27 – Median Estimated Salt and Nitrate Loading from Conveyance Losses

	Santa Clara Plain	**Coyote Valley**	**Total**
Combined Conveyance Loss Volume*	10,050 AF/yr	40 AF/yr	10,100 AF/yr
Overall Conveyance Loss TDS Concentration *	256 mg/L	323 mg/L	
Overall Conveyance Loss Nitrate as NO_3 Concentration*	4 mg/L	8 mg/L	
Combined Salt Loading as TDS*	3,500 tons	20 tons	3,520 tons
Combined Nitrate as NO_3 Loading*	58 tons	0.45 tons	58 tons

* Ten-year median

3.3.1.10 Drainage Losses

Losses from storm drains, sewer laterals, and sewer mains loading from septic tank leach fields are grouped together as drainage losses. Because the quality and volumes of drainage losses are not directly measured, estimates from the technical literature are used for loading from this source. Sanitary system operators were also contacted to gain their perspectives and estimates of drainage loss volumes.

Exfiltration rates are considerably smaller than infiltration rates because wastewater causes soil clogging and sedimentation can plug sewer pipe defects (Karpf and Krebs, 2004). For most soil types, unsaturated soil transmits water less efficiently than the saturated conditions present during infiltration (i.e., unsaturated hydraulic conductivity is lower than saturated hydraulic conductivity). Leaks from sewers are self-sealing due to the rich organic content and microbial growth combining to form biofilms, called colmation layers which limit the volume of exfiltration (Ellis, J.B., 2001). However, colmation layers in sewers can be dislodged by flow surges caused by inflow during heavy rainfall events, sewer cleaning, or local increase in flow velocity following breakthrough of partial backup/blockages. It is therefore reasonable to assume some exfiltration and to assign S/N loading factors to exfiltration.

The rate of sewer line exfiltration was estimated based on pipe diameter and assumes 100 gallons per inch of internal diameter per mile of sewer over 24-hours (adapted from ASTM C 969). This method was applied for all parts of the sewer systems within the Santa Clara Plain and outside the zone where depth to water is 10 feet or less, i.e., where groundwater intrusion

to sewer lines may occur. The resulting volume is about 1.8% of the average daily flow to all three wastewater treatment plants. This percentage is at the low end of the range of sewer system losses reported in the technical literature (Amick and Burgess, 2000).

A low estimate of sewer line exfiltration is appropriate for SNMP based on two considerations. First, sewer system management plans published for the sewer systems in the Santa Clara Plain identify specific preventive maintenance measures and vigilant inspection programs. Second, sewer line defects are often self-sealing as described above. To estimate loading we used the volume-weighted average of the TDS and nitrate measured on the influent to all three wastewater plants serving the Santa Clara Plain, based on 10-year medians for each plant.

Most of the Coyote Valley is not sewered. For this analysis, the residential section of Morgan Hill that is sewered and located within the Coyote Valley is ignored.

The estimated average volume of septic effluent is 99,000 gallons per septic system per year, based on literature data for per capita wastewater generation. There are only about 70 septic tanks in the Santa Clara Plain, located at the southern end of the Almaden Valley, while the Coyote Valley has about 600 septic tanks. Locations of areas served by septic tanks are shown in Figure 19.

The estimated volume of stormwater losses is based upon assumptions regarding the amount of rainfall that runs through storm drains to creeks, and an assumed exfiltration rate of 1.3%.

The quality of water in the drainage loss term was determined from measurements and from literature values. Wastewater quality measurement of specific conductance (electrical conductivity) and ammonia were converted to TDS and nitrate to obtain volume-weighted averages for all three wastewater plants. The quality of septic effluent was estimated as the median of values presented in 18 literature studies that measured septic effluent quality.[19] Stormwater quality is estimated based on creek samples reported by the Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP). Table 28 summarizes estimated volumes, concentrations, and salt and nitrate loading from drainage losses.

Table 28 – Median Estimated Salt and Nitrate Loading from Drainage Losses

	Santa Clara Plain	**Coyote Valley**	**Total**
Combined Drainage Loss Volume*	2,470 AF/yr	162 AF/yr	2,630 AF/yr
Overall Drainage Loss TDS Concentration*	824 mg/L	575 mg/L	
Overall Drainage Loss Nitrate as NO_3 Concentration*	33 mg/L	169 mg/L	
Combined Salt Loading as TDS*	2,770 tons/yr	127 tons/yr	2,900 tons/yr
Combined Nitrate as NO_3 Loading*	112 tons/yr	32 tons/yr	144 tons/yr

* Ten-year median

[19] Brown K.W., et al., 1978; Feth, J.H., 1966; Popkin, R.A., and Bendixen, T.W., 1968; Brown and Caldwell, 1981; Biggar, J. W., and Coney, R.B., 1969; Taylor, J., 2003; Zhan & Mackay, 1998 (citing Canter & Knox); Effert, D., et al., 1985; Dudley, J .G., and Stephenson, D.A., 1973; Otis R.J., et al., 1975; Metcalf & Eddy, 1972; Hansel, M.J., and Machmeier, R.E., 1980; Bicki, T.J., et al., 1984; Brooks J.L., et al., 1984; Lowe, K., et al., 2007 SCVWD, 1994; Alhajjar, et al., 1989; Canter, L.W., and Knox, R.C., 1985; Conn, K.E., and Siegrist, R.L., 2007; Panno, S.V., et al., 2005; Kaplan, O.B., 1991.

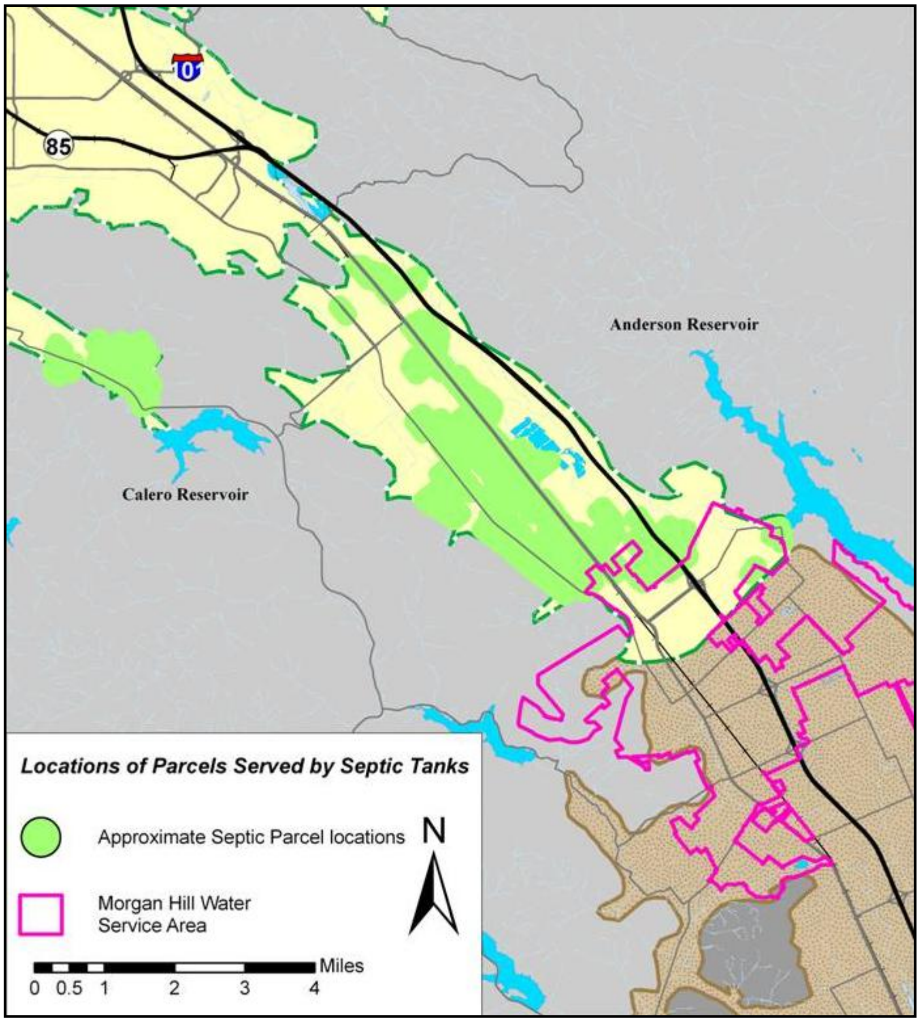


Figure 19- Locations of Areas Served by Septic Tanks

3.3.2 Dry Loading

Dry loading refers to the salt and nitrate loading from dry sources such as fertilizer, soil amendments, and atmospheric deposition. Salt and nitrate loading from dry sources is not directly measured, so estimates were developed from 2011 crop data and University of California Cooperative Extension guidance of fertilizer application rates, from literature on lawn fertilizer, and from published model results of regional atmospheric deposition rates for nitrogen.

3.3.2.1 Agricultural Fertilizer and Lawn Fertilizer

Fertilizers applied to crops and turf at parks and on residential lawns contribute salt and nitrate to groundwater where conditions favor leaching. To estimate nitrate and salt loading from agricultural fertilizer use, 2011 cropping patterns were obtained from the County Agricultural Commissioner's office. Crop fertilizer application rates by type were compiled from University of California Cooperative Extension agriculture technical literature. Rates of fertilizer application vary by crop type, and cropping patterns vary over time. For the purposes of this SNMP, the 2011 crop acreages are considered representative of a typical year, and loading rates

developed for 2011 were applied to 2001–2010. Fertilizer adds mineral salts in addition to nitrogen. The rate of salt loading from agricultural fertilizer application was estimated from the typical fertilizer application rates for the crops grown in the Santa Clara Groundwater Subbasin, and the common composition of each fertilizer type.

The area of parks and residential lawns where fertilizers may be applied was estimated from the LAMS GIS raster.[20] No local data on the frequency and rate of fertilizer application on residential lawns and municipal parks was available. To render an estimate, the assumption is made that half the lawns and parks apply fertilizer in a given year. The rate of application was taken as 3.5 lbs nitrogen per 1,000 square feet, i.e., about 150 lbs per acre (UCD, 2002). The rate of nitrate attenuation for dry lawn fertilizer, listed in Table 16 (95%), was determined from a review of the technical literature. Only 5% of nitrogen in lawn fertilizer is assumed to leach to groundwater as nitrate. Because nitrate is 4.43 times heavier than nitrogen, the effective leaching rate for nitrate to groundwater from lawn fertilizer is 34 lbs NO_3/acre. Tables 29 and 30 list the estimated salt and nitrate loading rates from agricultural and lawn fertilizer.

Table 29 – Estimated Salt and Nitrate Loading from Agricultural Fertilizer

	Santa Clara Plain	Coyote Valley	Total
Acres fertilized	1,007 acres	1,273 acres	2,280 acres
Average fertilizer nitrate leaching rate – per acre	155 lbs NO_3	184 lbs NO_3	171 lbs NO_3
Fertilizer salt loading as TDS	40 tons/year	56 tons/year	96 tons/year
Fertilizer Nitrate as NO_3 Loading (leached to groundwater /year)	78 tons NO_3	117 tons NO_3	195 tons NO_3

Table 30 – Estimated Salt and Nitrate Loading from Lawn Fertilizer

	Santa Clara Plain	Coyote Valley	Total
Acres fertilized/year*	4,475 acres	175 acres	4,650 acres
Average application rate, pounds NO_3 per acre (includes 95% attenuation)	34 lbs NO_3 leached to groundwater per fertilized acre	34 lbs NO_3 leached to groundwater per fertilized acre	34 lbs NO_3 leached to groundwater per fertilized acre
Average application rate, pounds salt per acre	161 lbs TDS per acre	160 lbs N per acre	160 lbs N/acre
Fertilizer salt loading as TDS	360 tons/year	15 tons/year	375 tons/year
Fertilizer Nitrate as NO_3 Loading	76 tons/year	3 tons/year	79 tons/year

*Assumes 50% of lawns and parks are fertilized in a given year.

[20] LAMS = Large Area Mosaicing Software, a high-resolution infrared-band imagery coverage from which irrigated land uses can be differentiated.

3.3.2.2 Atmospheric Deposition

Atmospheric deposition refers to particles, aerosols, and gases that move from the atmosphere to ground surface.[21] Dry deposition originates from a variety of natural and air pollution sources that contribute nitrate and salt to groundwater. Dry deposition is difficult to measure so estimates of dry deposition rely on models that combine measured concentrations of nitrogen species with calculated deposition velocities. Uncertainties in dry deposition estimates are between 30 to 50%. Dry deposition data were obtained from US EPA, which maps deposition patterns nationally, based on modeled interpolation of a sparse regional network of non-urban atmospheric deposition monitoring stations. The monitoring stations are located primarily in national parks. The nearest available dry deposition data for total nitrogen (Fremont) was obtained from the California Air Resources Board. An interpolated grid of nitrogen dry deposition model estimates was obtained from California Energy Commission reports and interpreted following the approach used in a local study by Weiss (1999). Applying a series of scaling factors based on relationships among air pollution factors, the estimated total N dry deposition rate for open grassland or cultivated areas in Coyote Valley is calculated to be on the order of 11 to 15 kg nitrogen/hectare/year (N/ha/yr) (Weiss, 1999). For this calculation, the low end of the range was used (11 kg N/ha/yr) for the Coyote Valley. For the Santa Clara Plain, the modeled estimates of atmospheric depositions range from 3.9 to 8.4 kg N/ha/yr (Tonnesen et al., 2007).

Vehicle emissions represent the primary source of atmospheric nitrogen deposition in close proximity to high-traffic freeways and roads (Collins, 1998). Land within 100 meters of high-traffic corridors (freeways, highways, and expressways/arterial roads) was assigned a higher nitrogen flux value and added to the grid of modeled nitrogen loading to account for the Bay Area funnel effect that directs smog from San Francisco, San Mateo, and Alameda counties into the Santa Clara Valley. Nitrogen deposition in Santa Clara County is dominated by dry deposition due to the pattern of long dry summers and winter rains, and often exceeds wet deposition by 10 to 30 times (Blanchard, et al., 1996). For land within 100 meters of high-traffic corridors, 11 kg N/ha yr was used. Traffic corridors in Coyote Valley are included with the 11 kg N/ha/yr estimate.

The properties of the surfaces upon which nitrogen is deposited determine whether nitrate is added to the groundwater basin. Impervious surfaces such as roofs, roads, and parking lots, transfer nitrogen of atmospheric origin to stormwater, and ultimately to the Bay. Land areas that are cultivated, landscaped, or undeveloped facilitate deep percolation of a portion of the atmospheric nitrogen to groundwater.

Once deposited to vegetated ground surfaces, nitrogen of atmospheric origin may volatilize, be taken up by plants (through the root zone or through leaf stomata), or become dissolved in water, some of which will run off as surface water, and some of which will contribute to deep percolation of nitrate to underlying groundwater. Dissolved nitrate may further undergo denitrification in the subsurface. The following assumptions regarding nitrate fate and transport are made (as listed in Table 16):

- 80% of the nitrogen is taken up by plants (primarily grasses).
- 15% is volatilized or denitrified to gaseous nitrogen.
- 5% is converted to nitrate and percolates to groundwater.

[21] Atmospheric deposition also refers to wet precipitation (rain and snow), which also contribute salt and nitrate to groundwater, and are addressed in Section 3.3.1.1.

Inspecting the LAMS image data and the MRLC[22] cover imagery in GIS, the average ratio of irrigated and vegetated area to total area in the Santa Clara Plain area of the Santa Clara Groundwater Subbasin is 24%. Therefore, 76% of the atmospheric deposition of nitrogen is likely removed by rainfall runoff.

Table 31 – Estimated Salt and Nitrate Loading from Atmospheric Deposition

Category	Total N kg/ha/yr	Annual Nitrate as NO_3 Loading, tons/yr [1]		
		Santa Clara Plain	**Coyote Valley**	**Subbasin Total**
Areal Deposition on Santa Clara Plain from CMAQ[2] modeled estimate	3.9–8.4	10	1.25	11.25
High-Traffic Corridors + Coyote Valley	11	11.5	0.3	11.8
Total Nitrate		**21.5**	**1.55**	**23**
Salt as Dry Deposition of TDS [4]	**5 yr range kg/ha/yr**	**Santa Clara Plain [3]**	**Coyote Valley**	**Subbasin Total**
	0.22 – 1.29	30	1.8	32

[1] Total N-deposition converted to nitrate as NO_3 (multiply by stoichiometric conversion factor 4.43) subject to deep percolation to groundwater (5%).
[2] CMAQ: Congestion Mitigation and Air Quality Improvement model. See Tonneson et al, 2007.
[3] On average 76% of Santa Clara Plain ground surface is impervious and assumed to facilitate removal of atmospheric salt and nitrate deposits to stormwater, which removes it from the groundwater subbasin.
[4] TDS is taken as the sum of US EPA's Clean Air Status and Trends Network (CASTNET) data for sulfate, chloride, calcium, magnesium, sodium, and potassium.

3.3.3 Salt and Nutrient Removal

Groundwater leaving the Santa Clara Groundwater Subbasin aquifers carries salt and nitrate and comprises a removal term in the overall salt balance. Groundwater removal occurs naturally through basin outflow and in gaining reaches of streams. Groundwater removal also occurs through groundwater pumping and through groundwater infiltration into sewer pipes and storm drains located beneath the water table. This section inventories the volumes of groundwater leaving the subbasin and the associated salt and nitrate removal. Table 32 summarizes salt and nitrate removal from all of these removal categories following their descriptions in the next sections.

3.3.3.1 Groundwater Pumping

The District meters pumping from major production wells and uses reported production from other wells to account for a detailed and accurate inventory of groundwater pumping. Pumping categories include municipal and industrial, environmental, domestic, and agricultural wells. For each category, reported volumes were multiplied by groundwater concentrations of nitrate and salt. The largest volume of pumping is from municipal supply wells. S/N removal from municipal supply wells was calculated by multiplying metered volumes and S/N concentrations corresponding to the retailer service areas, using water quality data supplied by retailers to

[22] Multi-Resolution Land Characteristics Consortium – www.MRLC.gov

DDW. No attenuation is assigned for pumping, which removes S/N already dissolved in groundwater. For industrial, environmental, domestic, and agricultural wells, the groundwater basin average concentrations were used. Some of the salt and nitrate in groundwater is returned to the basin, which is accounted for in the wet loading terms described in Section 3.3.1. Table 32 summarizes S/N removal by groundwater pumping.

3.3.3.2 Basin Outflow

The volume of groundwater leaving the subbasin by flowing into aquifers north of the Santa Clara Plain or from the Coyote Valley into the Santa Clara Plain is not measured directly. Groundwater flow models are used to estimate basin outflow volumes, which are multiplied by volume-weighted average concentrations for TDS and nitrate. Estimates of S/N removal attributable to basin outflow are provided in Table 32.

3.3.3.3 Gaining Reaches of Streams

Where groundwater elevations are higher than the stream bottom[23] groundwater may discharge into the stream. Groundwater discharge to streams generally occurs in sections of streams located near the Bay called gaining reaches of streams. Gaining reaches of streams also occur in Fisher and Coyote Creeks at the northern end of the Coyote Valley, where decreasing depth to bedrock causes a shallow groundwater condition. The volume of groundwater discharging to streams was estimated by stream gauging and calibration of groundwater flow models. The estimated removal of S/N from Coyote Valley that is attributable to gaining reaches of streams was obtained by multiplying this volume by the volume-weighted average concentrations of TDS and nitrate in Coyote Valley. The Santa Clara Plain groundwater flow model was calibrated without including a module for gaining reaches of streams, so an estimate of groundwater discharge to streams is not available. Stream gauging to estimate groundwater discharge to streams in the Santa Clara Plain is made difficult by tidal fluctuations in the lower reaches of streams. Table 32 summarizes S/N removal by gaining reaches of streams in Coyote Valley.

3.3.3.4 Groundwater Infiltration into Sewer Lines and Storm Drains

Where sewer mains and storm drains are buried below the water table, groundwater may enter under hydrostatic pressure through defective joints, cracks, or other openings. A detailed review of Groundwater Infiltration (GWI) estimation methods and estimates of the mass of S/N removed by GWI is provided as Appendix 5. Results of these estimates are included in Table 32.

3.3.3.5 Storm Drain Infiltration

Storm drains in both the Santa Clara Plain and the Coyote Valley may remove groundwater where they are submerged year-round or seasonally. In the lower reaches of the Guadalupe River, Coyote Creek, and other creeks, stormwater is discharged through flood control levees using stormwater pumps. The occasional operation of these pumps during the summer is due to storm drain conveyance of infiltrated groundwater. While the volumes pumped during summer are not measured, the discharges are regular and move a substantial volume of groundwater. To estimate the magnitude of groundwater infiltration into storm drains, an estimate of exfiltration was developed and the ten-fold infiltration estimation factor described in

[23] The “stream bottom” is the thalweg, i.e., the deepest point in the stream channel cross-section – akin to the invert in an engineered channel. Discharge into the stream may be impeded by clay layers.

3.3.1.10 was applied. The analysis of groundwater infiltration into storm drains is presented in Appendix 5, and results are included in Table 32.

Table 32 – Salt and Nutrient Removal

Category		Santa Clara Plain	Coyote Valley
10-year Median Volume-weighted TDS concentration †		Shallow: 536 mg/L Overall: 427 mg/L	376 mg/L
10-year Median Volume-weighted NO_3 concentration †		Shallow: 9 mg/L Overall: 11 mg/L	20 mg/L
1. Groundwater Pumping	Volume	91,800 AF/yr	13,600 AF/yr
	Salt Removal	49,000 tons/yr	6,700 tons/yr
	Nitrate Removal	730 tons/yr	400 tons/yr
2. Basin Outflow	Volume	6,000 AF/yr	4,870 AF/yr
	Salt Removal	3,360 tons/yr	2,490 tons/yr
	Nitrate Removal	90 tons/yr	160 tons/yr
3. Gaining Reaches of Streams	Volume	-	3,280 AF/yr
	Salt Removal	-	1,670 tons/yr
	Nitrate Removal	-	110 tons/yr
4. Infiltration into Sewer Lines	Volume	2,930 AF/yr	-
	Salt Removal	2,520 tons/yr	-
	Nitrate Removal	28 tons/yr	-
5. Infiltration to Storm Drains	Volume	4,380 AF/yr	-
	Salt Removal	3,200 tons/yr	-
	Nitrate Removal	46 tons/yr	-
TOTALS	Volume	**105,100 AF/yr**	**21,750 AF/yr**
	Salt Removal	**58,080 tons/yr**	**10,860 tons/yr**
	Nitrate Removal	**890 tons/yr**	**670 tons/yr**

† In the Santa Clara Plain, shallow concentrations were applied for sewer line and storm drain infiltration, and total basin concentrations were applied to basin outflow and gaining reaches of streams. Shallow and deep aquifers are not differentiated in the Coyote Valley.

3.3.4 Overall Salt and Nitrate Balance

The sum of all the individual salt and nitrate loading and removal categories provides the overall salt balance for the Santa Clara Plain and for the Coyote Valley. Table 33 provides the overall salt balance.

Table 33 – Overall Salt and Nitrate Balance

Salt and Nutrient Loading	Santa Clara Plain				Coyote Valley			
	TDS, tons/yr	%	Nitrate as NO_3, tons/yr	%	TDS, tons/yr	%	Nitrate as NO_3, tons/yr	%
Rainfall Recharge	180	0.2%	8.2	0.7%	29.9	0.38%	1.4	0.6%
Mountain-front Recharge	4,600	5.1%	44	3.9%	-	-	-	-
Basin Inflow	4,140	4.6%	230	20.4%	-	-	-	-
Managed Recharge†	24,720	27.6%	39	3.5%	4,684	60%	3	1.5%
Agricultural Irrigation	320	0.4%	3	0.3%	2,070	26%	49	21.7%
Landscape Irrigation	42,270	47.1%	322	28.5%	844	10.8%	18.2	8.1%
Landscape Irrigation with Recycled Water	6,725	7.5%	141	12.5%	-	-	-	-
Conveyance Losses	3,500	3.9%	58	5.1%	20	0.25%	0.45	0.2%
Drainage Losses	2,770	3.1%	112	9.9%	127	1.6%	32	14.1%
Agricultural Fertilizer	40	0.04%	78	6.9%	56	0.71%	117	52%
Lawn Fertilizer	360	0.4%	76	6.7%	15	0.19%	3.1	1.4%
Atmospheric Deposition	30	0.03%	21.5	1.9%	1.8	0.02%	1.5	0.7%
TOTAL LOADING	**89,660**	**100%**	**1,130**	**100%**	**7,850**	**100%**	**226**	**100%**
Salt and Nutrient Removal	**Santa Clara Plain**				**Coyote Valley**			
	TDS, tons/yr	**%**	**Nitrate as NO_3, tons/yr**	**%**	**TDS, tons/yr**	**%**	**Nitrate as NO_3, tons/yr**	**%**
Groundwater Pumping	49,000	84.4%	730	82%	6,700	62%	400	60%
Basin Outflow	3,360	5.8%	90	10%	2,490	23%	164	24%
Gaining Reaches of Streams	-	-	-	-	1,670	15%	110	16%
Infiltration into Sewer Lines	2,520	4.3%	28	3%	-	-	-	-
Infiltration into Storm Drains	3,200	5.5%	46	5%	-	-	-	-

TOTAL REMOVAL	**58,080**	**100%**	**890**	**100%**	**10,860**	**100%**	**670**	**100%**
NET LOADING	**31,520**	**tons/yr**	**240**	**tons/yr**	**- 3,010**	**tons/yr**	**- 444**	**tons/yr**

† The value listed is the median of the 10-year sums of creek and pond recharge, which differs from the sum of the 10-year medians of creek and pond recharge listed in Tables 21and 22, because the median is not a distributive property.

3.4 Assimilative Capacity

Assimilative capacity is the difference between the ambient groundwater quality and the Basin Plan Objective. For example, if measured TDS averaged over the groundwater basin is 300 mg/L, and the Basin Plan Objective is 500 mg/L, assimilative capacity is 200 mg/L. The SWRCB Recycled Water Policy stipulates that the available assimilative capacity should be calculated using the most recent five years of available data or a time period approved by the RWQCB. This SNMP uses data from 2008 through 2012 to calculate assimilative capacity.

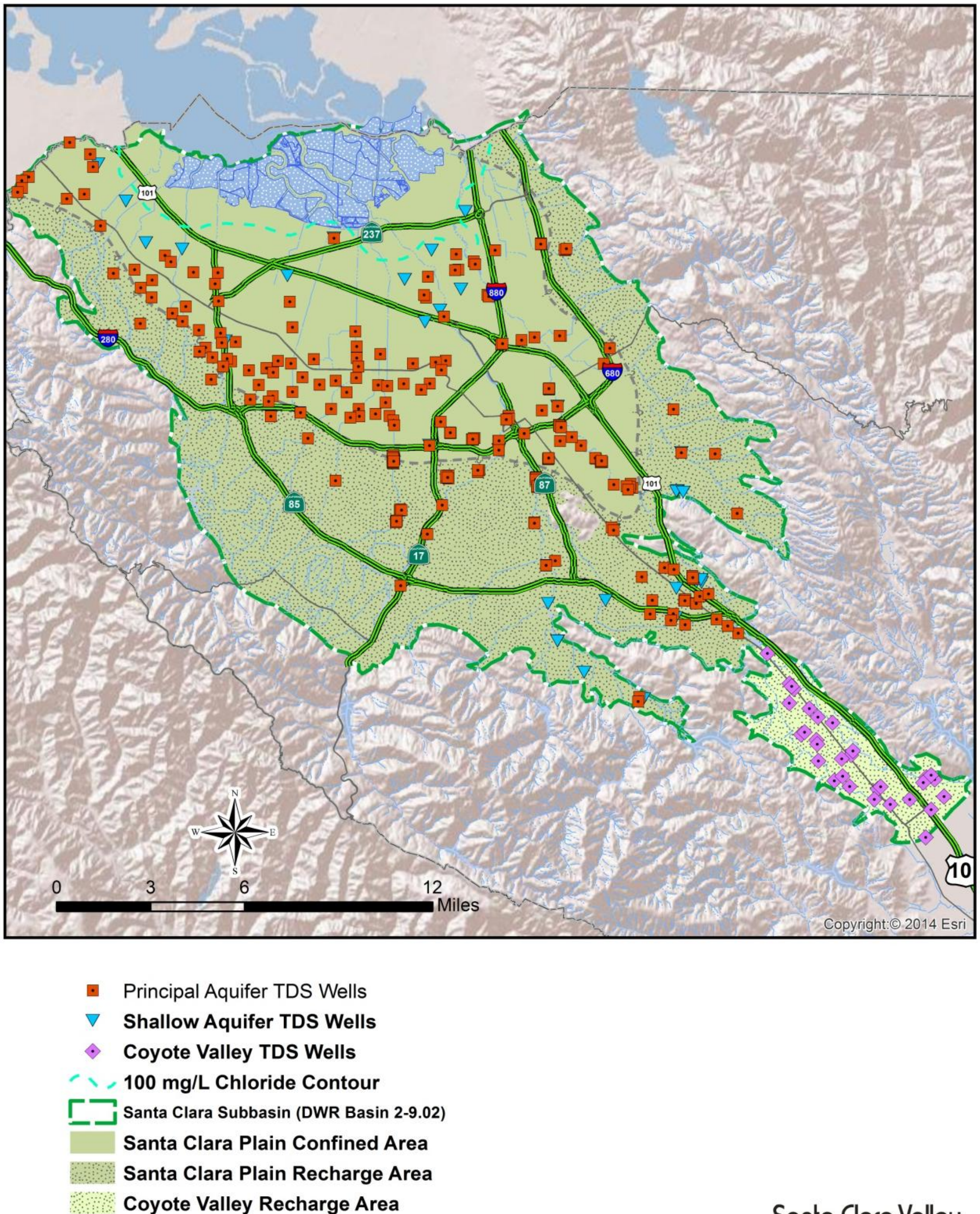
3.4.1 Ambient Groundwater Quality

Data for the two indicator parameters, TDS and nitrate as NO_3, were obtained from the District's regional groundwater monitoring program and from data reported by water retailers to the DDW. Where multiple analyses are available for a given well in the same year, the average of all the sample results was used for that year.

The Santa Clara Plain has a zone of saline intrusion in the Baylands as described in Section 3.3.1.3. A regional aquitard separates the shallow aquifer from the principal aquifer as described in Section 2.1. There are two areas where TDS is high in the principal aquifer due to mineral salts of geogenic origin. The two areas with elevated TDS are located in Palo Alto and in a portion of the Evergreen area (see Figure 17). Sediments of marine origin may contain salts of the original seawater that may be the source of these higher dissolved solids (Metzger and Fio, 1997). The areas in question are of limited extent; however they were included in the determination of volume-weighted average concentration.

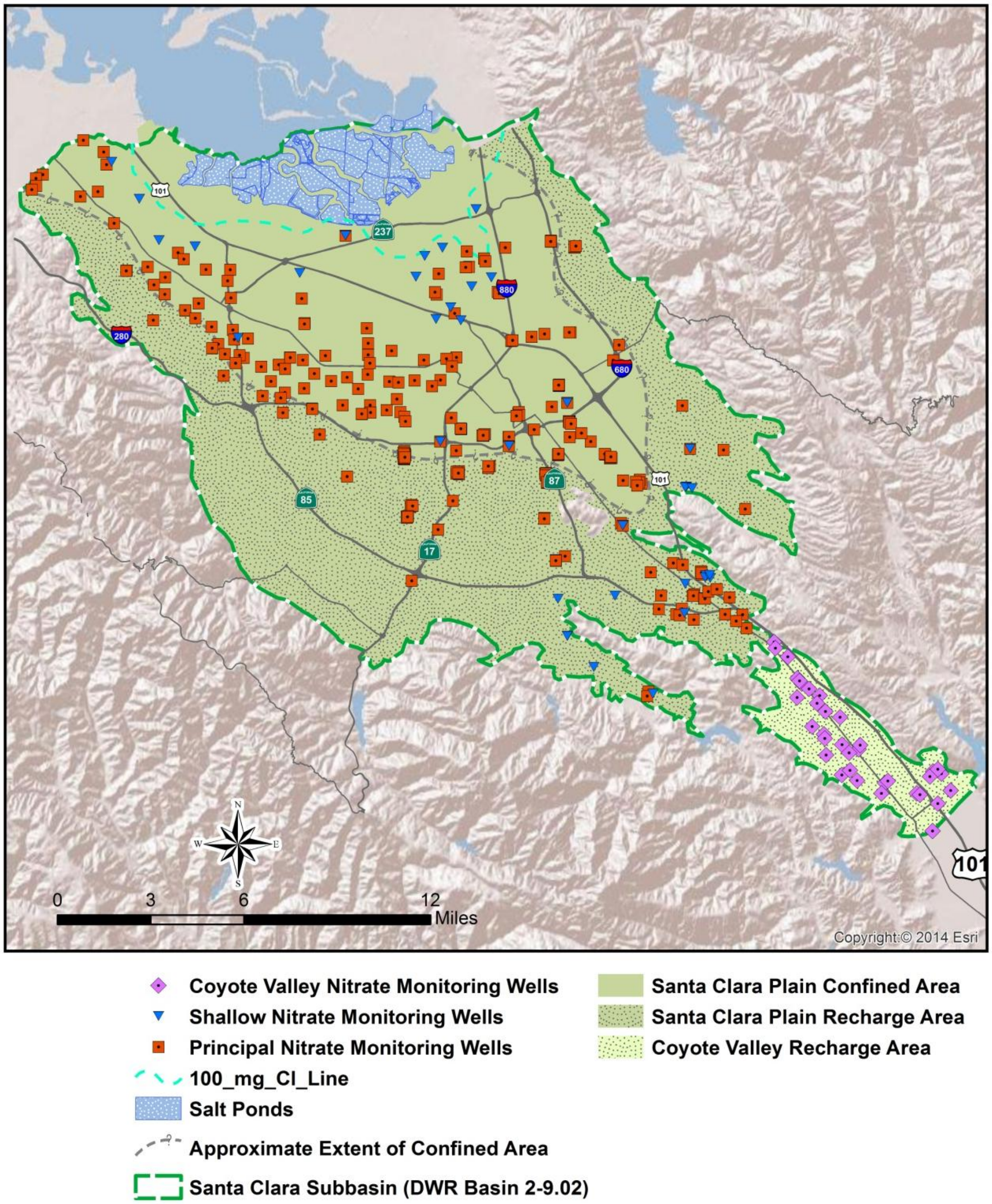
Figure 20 shows the locations of wells used to determine the basin average TDS concentrations in the Santa Clara Plain, and wells used to determine basin average nitrate concentration are shown in Figure 21.

In general, shallow monitoring wells have higher TDS than the wells completed in the principal aquifer below the confined zone. Therefore, averages for TDS and nitrate as NO_3 were determined separately for the shallow and deep aquifers. A single volume-weighted average was determined for both the Santa Clara Plain and Coyote Valley.



Santa Clara Valley Water District

Figure 20 – Locations of Wells used to Determine Volume Weighted Average Concentration of Total Dissolved Solids in the Santa Clara Plain and Coyote Valley



Santa Clara Valley Water District

Figure 21 – Locations of Wells used to Determine Volume Weighted Average Concentration of Nitrate as NO3 in the Santa Clara Plain and Coyote Valley

3.4.2 Volume-Weighted Average Basin Concentrations

Volume-weighted averages were developed for yearly data from 2008 through 2012 for the saturated thickness of the shallow and principal aquifers. MODFLOW model grid cells and depth to water data were used to estimate saturated aquifer volume, and the wells were assigned to shallow or principal aquifers based on their depths. Concentration data from wells corresponding to each model layer were gridded using Surfer Software's universal kriging option. Gridded values were averaged over the model cells, and the concentrations assigned to each model cell were multiplied by the cell volume and the estimated porosity. The mass of TDS or nitrate as NO_3 was summed for each model layer, and the totals from each layer were summed to obtain the overall mass in the Santa Clara Plain. The overall mass was divided by the overall volume to obtain volume-weighted averages for the shallow and principle aquifers, and for a single average, as summarized in Table 34. For the Coyote Valley, available water quality data was interpolated using Thiessen polygons[24] ArcGIS software. Values in the Thiessen polygons were assigned to model grid cells to estimate mass, and divided by the total volume in the Coyote Valley, to yield a volume-weighted average concentration. The resulting concentrations for both subareas are contrasted with the Basin Plan Objectives to determine assimilative capacity in Table 34.

To determine the basin volume available for mixing, a specific yield was considered representative of the volume involved with active, short-term mixing. Nitrate and the solutes measured in TDS analysis participate in diffusion over the long term, which includes the total effective porosity. Therefore, porosity was used instead of specific yield. Staff considered the estimated porosities of basin aquifer materials, and used a porosity of 30% for the shallow aquifer and 25% for the principal aquifer in the Santa Clara Plain, and 30% for all of the Coyote Valley.

Table 34- Factors Used to Determine Volume-Weighted Average Concentrations

SANTA CLARA PLAIN			**Available Mixing Volume, AF**	**Vol-Wt. Avg. Conc. 2008 – 2012**	
Aquifer	**Saturated Volume, AF**	**Porosity**		**TDS, mg/L**	**Nitrate as NO_3, mg/L**
Shallow	10,790,700	30%	3,237,200	528	9.1
Principal	86,682,200	25%	22,509,700	410	11.0
Overall	97,472,900	25%	25,746,900	425	10.7
COYOTE VALLEY				**Vol-Wt. Avg. Conc. 2008 – 2012**	
				TDS, mg/L	**Nitrate as NO_3, mg/L**
Overall	644,650	30%	644,650	377	20.0

[24] Thiessen Polygons, also called Voronoi Cells, are a method for subdividing an area based on locations of data points (e.g., wells or rain gages). Polygons are formed by line segments perpendicular to the midpoints of lines formed by connecting adjacent points. Thiessen polygons are used to develop an area-weighted distribution of data across a spatial domain to lessen the effect of clustered data or data gaps.

Table 35 – Assimilative Capacity in the Santa Clara Plain and Coyote Valley

Sub-Area/Aquifer	Vol-Wt. Avg TDS, mg/L	TDS Assimilative Capacity	Vol-Wt. Avg Nitrate as NO_3	NO_3 Assimilative Capacity
Basin Plan Objective	***500***		***45***	
Santa Clara Plain – Shallow	528	**-28**	9.1	**35.9**
Santa Clara Plain – Principal	410	**90**	11.0	**34.0**
Santa Clara Plain – Overall	425	**75**	10.7	**34.3**
Coyote Valley	377	**123**	20.0	**25.0**

3.4.3 Estimated Basin Assimilative Capacity

The assimilative capacities listed in Table 34 show that for the Santa Clara Plain overall, there is an assimilative capacity of 75 mg/L for TDS and 34.3 mg/L for nitrate as NO_3. The Coyote Valley has lower average TDS concentration, with an assimilative capacity of 123 mg/L. Nitrate as NO_3 concentrations in the Coyote Valley are higher with an assimilative capacity of 25 mg/L.

3.4.4 Projecting Future Assimilative Capacity

Future assimilative capacity can change with variation in salt loading and removal and associated changes in TDS and nitrate concentrations. The approach used for projecting future concentrations involves projecting changes to TDS and nitrate loading and removal. This section discusses the basis for the assumptions applied to make these projections, and explains the results of calculations of future assimilative capacity.

3.4.4.1 Assumptions for Future Loading

The Recycled Water Policy stipulates that SNMPs should calculate S/N loading impacts for no less than a ten-year time frame. In order to coincide with the planning period for the 2010 Urban Water Management Plan, the planning horizon selected is 2010 through 2035. In this timeframe, a number of anticipated changes will impact water use and quantities of salt and nitrate in groundwater. These anticipated changes are based on projections for water demand and water conservation detailed in the Urban Water Management Plans published every five years. Future actions that can affect (increase or decrease) the salt and nitrate loading include the following:

- Improved recycled water quality from advanced treatment.
- Planned increases in recycled water use.
- Planned indirect potable reuse using advanced-treated recycled water.
- Planned rehabilitation of known problems with infiltration of saline water into sewer lines.

- Decreasing trends in pumping for environmental remediation.
- Planned outdoor water conservation initiatives.
- Planned capital improvements to increase recharge system capacity.
- Anticipated increases in drainage losses due to increased sewer flows and storm drain losses (septic component is assumed to be constant).
- Anticipated increases in conveyance losses associated with increases in water use.

While there are many forecasts for long-term variation in rainfall, evapotranspiration, and sea level rise in response to climate change (i.e., in 50 to 100+ years), there are only a few studies available that estimate local conditions in the near term (i.e., in the next 25 years). For the SNMP planning horizon, there are not sufficient local studies of rainfall and evapotranspiration changes to render a projection, so these factors were held constant. Similarly, the possible effects from sea level rise on delta water quality and local saline incursion of streams over the next 25 years is not considered for these projections due to lack of a reliable short-term forecasts. Table 35 lists the numeric factors used to forecast changes to salt and nitrate loading to groundwater.

Table 36 – Basis of Future Loading Projections by Category

LOADING Landscape Irrigation	Tied to Urban Water Management Plan water demand and water conservation projections; assumes 45% outdoor water use overall. About 90% of SJWC's projected 7,000 AF new recycled water irrigation is retrofit displacing existing landscape irrigation with potable water. Increased loading from irrigating with higher TDS recycled water is included in the Recycled Water Category.
Other Irrigation	Held constant. Includes domestic well outdoor irrigation parks, golf course irrigation, and agricultural irrigation.
Managed Recharge	20,000 AF/yr of advanced treated recycled water is forecasted to be available for additional groundwater recharge by 2030. Future loading includes the IPR scenario (20,000 AF/yr by 2030), and new recharge from upgrade of the Kirk Diversion Dam (920 AF/yr by 2015), Alamitos Diversion Dam (440 AF/yr by 2018), and the Coyote Diversion Dam (1,000 AF/yr by 2020) per the 5- year Capital Improvements Program report. In addition, the Water Supply Infrastructure Master Plan includes a new recharge facility in the west part of the Santa Clara Plain with a 3,300 AF/yr capacity, for which 1,650 AF/yr recharge is projected (total of all new recharge = 4,000 AF/yr).
Natural Recharge	Held constant.
Recycled Water	Non-potable recycled water used for irrigation is projected to increase from about 7,000 AF in 2010 to 26,500 AF in 2035. Advanced treated recycled water will be blended with tertiary-treated recycled water to achieve a TDS of 500 mg/L. Sunnyvale plans long term addition of 2,061 AF/yr and forecasts improved TDS at 760 mg/L. Palo Alto achieved a TDS reduction from 950 mg/L to 770 mg/L in 2013 and forecasts achieving 600 mg/L by 2018 if identified projects are funded and completed (included in the forecast).
Drainage Losses	Drainage losses will increase from 2,100 tons TDS/year to 2,600 tons per year according to projected increases in wastewater and stormwater volumes, and the resulting loading will increase slightly based on projected water quality changes in response to water conservation.
Conveyance Losses	Increases proportional to projected increases in demand.
Fertilizer	Held constant.
Atmospheric Deposition	Held constant – assumes increased number of vehicles is offset by improved emissions controls and increased use of alternative fuel vehicles.
REMOVAL Saline Infiltration of Sewer Lines	In 2013, Palo Alto sleeved Mountain View Trunk Line reducing TDS from 950 to 775 mg/L. This trunk line contributes 31% of the 21.7 MGD total flow to the plant. The reduction in annual removal from saline infiltration of sewer lines is 732 tons per year in 2013, and 2,240 by 2022 (included in the forecast).[B]
Retailer pumping	Increases per 2010 UWMP Projections.
Non-Retailer Pumping	Agricultural pumping decreases in both the Coyote Valley and the Santa Clara Plain per the projection in Urban Water Management Plan. [C] Overall, the Santa Clara Plain non-retailer pumping decreases due to the continuing trend of declining environmental pumping.
Basin outflow/gaining streams	Held constant.

Definitions: Other Irrigation = agricultural irrigation, irrigation from domestic wells, irrigation of parks, golf courses, cemeteries, etc.; Managed Recharge = combined recharge from percolation ponds and in-stream recharge (includes Indirect Potable Reuse, which is not counted in the Recycled Water Category); Natural Recharge = mountain front, rainfall, and losing reaches of streams; Drainage Losses = sewer line exfiltration, storm drain exfiltration, and septic tank leach field effluent; Conveyance Losses = real losses from retailer distribution systems and regional transmission losses; Fertilizer = combined agricultural and lawn and garden fertilizer; Atmospheric Deposition = dry deposition of nitrogen exclusive of rainfall. **References:** A) RMC, 20 13 B) City of Palo Alto, 2013 C) SCVWD, 2010

3.4.4.2 Methodology and Assumptions for Mixing Calculation

The procedure used to determine the change in concentration resulting from loading and removal of salts and nitrate is a basic mixing equation, in which the following assumptions are made:

- Mixing occurs within the year that the loading occurs, i.e., mixing is considered to be instantaneous.
- Mixing involves the entire saturated volume, including both the shallow and principal aquifers. Accordingly, the geographic locations of different loading sources (e.g., recycled water vs. septic tanks) are inconsequential for determining a change in basin-wide average concentration for the combined shallow and principal aquifers.
- The role of the confining clay layer (aquitard) in isolating the principal aquifer can be ignored for the purposes of determining changes in overall basin concentration.
- The effects of changes in rates of loading or removal are instantaneous.
- The unsaturated zone is in steady state with respect to sorption therefore, transit of salt and nitrate through the unsaturated zone is taken as instantaneous.
- Attenuation of nitrate due to root uptake and denitrification does not delay its transit across the unsaturated zone.
- The volume of water in the groundwater basin remains constant.
- The relevant time step for determining changes in concentration is one year.

These assumptions allow for a simplified calculation of basin concentrations. Some of these assumptions exaggerate the effects of salt and nitrate loading and are therefore conservative. For example, the residence time of nitrate in the unsaturated zone may span 40 to 80 years, causing long-term delayed effects from present-day loading (Sebiloa et al., 2013). By assuming a single mixing volume, local variations in rates of concentration changes are not considered. This approach to forecasting future changes in concentrations cannot be applied to estimating salt and nitrate concentration changes in individual wells or specific areas. This simplified approach allows determination of basin-wide concentration changes that match available data for groundwater and source-water quality.

Subdividing the basin for salt and nitrate loading analysis based on hydrologic, geologic, and land-use characteristics was not pursued because data limitations would make the analysis of sub-areas less reliable. The number of available monitoring data points varies substantially from year-to-year within smaller areas. Moreover, the variation of land use throughout the subbasin subareas is relatively small. For example, the Santa Clara Plain is primarily suburban/urban with no substantial agricultural areas. The most pronounced variation in land use is between the Coyote Valley, which is primarily rural/suburban, and the Santa Clara Plain, which is primarily suburban/urban; therefore, these two subareas were evaluated separately.

The mixing equation used to evaluate future groundwater salt and nitrate concentrations (S/N) can be stated verbally and symbolically as follows:

New Concentration = [Mass S/N Added + Mass S/N already in groundwater – Mass S/N removed]÷ groundwater volume

$$C_{n+1} = \left(\frac{M_{Ln} - M_{Rn} + (C_n \times V)}{V}\right)$$

where C_{n+1} is the new concentration, M_{Ln} is the mass of salt/nitrate loaded in year n, M_{Rn} is the mass of salt/nitrate removed in year n, C_n is the groundwater salt/nitrate concentration in year n, and V is the subarea aquifer saturated porosity volume.

The calculated new basin concentration is applied to groundwater sources of loading for the next year, setting up a feedback loop that accounts for salt accumulation or depletion due to successive net loading or net removal. Where the quantity of S/N loaded exceeds the quantity of S/N removed, the mixing equation will result in concentrations that are larger than the prior years, resulting in an upward trend. While measured concentrations in individual wells show flat or very slightly increasing or decreasing trends in salt and nitrate over the past fifteen years, the mixing equation predicts trends in the basin-wide averages that increase or decrease more rapidly. This departure in trend is attributable to the assumptions of instantaneous mixing, which does not reflect the relatively slow movement of groundwater. Accordingly, the projections provided for 2011–2035 are by nature, inflated because the concentrations changes will take much longer than 25 years to manifest.

3.4.5 Future Assimilative Capacity Projections

Long–term changes in basin–wide groundwater quality are typically slow and gradual because of the large volume of groundwater in storage. In order to account for variable hydrologic conditions, the starting concentration used to forecast future groundwater quality is taken as the median concentration in the 10–year baseline period (2001–2010). The Recycled Water Policy requires that groundwater quality be estimated a minimum of 10 years into the future. This SNMP includes projections from 2010 through 2035 – the planning horizon for the Urban Water Management Plans – to evaluate long-range changes to current trends that may result from planned changes to land and water use. To estimate future loading and removal for factors that are not expected to change loading and removal, rates were held constant at the median value from the 2001–2010 baseline period. Other loading and removal factors were systematically adjusted to reflect future changes in land use and water use, and are included in Urban Water Management Plans, Master Plans, and other planning documents, as noted in Table 35. Ongoing programs and policies that achieve groundwater quality management to mitigate S/N loading are described in Appendix 4.

The primary determinant of future changes in loading is forecasts of increased water use, including landscape irrigation with potable and recycled water. The Urban Water Management Plans (UWMP) prepared by each water retailer and the District's 2010 UWMP forecasts demand increase in response to population growth and planned developments, as well as conservation goals mandated by California's 20x2020 Water Conservation Plan and District water conservation efforts. Table 36 summarizes the changes in overall water use anticipated in the 2010 UWMPs.

Table 37 – Retailer Demand Projections after Conservation Savings(1) (AF/year)

Retailer	2015	2020	2025	2030	2035
Cal Water Service Co.	14,060	12,710	12,920	13,120	13,330
Great Oaks Water Co.[(3)]	13,260	13,420	13,830	14,250	14,660
Milpitas, City of[(4)]	15,280	16,240	17,220	18,240	19,320
Morgan Hill, City of[(4)]	8,970	8,520	8,990	9,580	10,160
Mountain View, City of[(5)]	14,280	14,860	15,430	16,000	16,750
Palo Alto, City of[(2)]	14,190	14,460	14,690	15,500	16,310
Purissima Hills Water District[(5)]	3,130	3,320	3,490	3,660	3,830
San José Municipal Water[(6)]	32,140	35,230	38,460	42,120	45,780
San José Water Company	143,790	147,860	150,930	154,080	157,290
Santa Clara, City of	31,260	33,050	34,610	36,070	37,430
Stanford University[(2)]	5,100	5,740	6,250	6,860	7,470
Sunnyvale, City of[(5)]	27,480	27,900	28,390	28,920	29,800
Independent Groundwater Pumping[(7)]	15,600	15,600	15,600	15,600	15,600
Totals	**338,540**	**348,910**	**360,810**	**374,000**	**387,730**
County-wide Agricultural Demand Projection[(8)]	**29,110**	**28,140**	**27,160**	**26,180**	**25,250**

(1) Includes conservation savings goal for both urban and agricultural conservation.
See Table 43 for total District water conservation program water savings goal with 1992 base year.
(2) 2035 values are a linear extrapolation of retailer provided data.
(3) From District developed demand projections based on ABAG Projections 2009 calibrated with actual use data.
(4) Figures shown are total demand for Morgan Hill. This SNMP accounts for Morgan Hill wells pumping in Coyote Valley and commercial/residential use north of Cochrane Road.
(5) Projections are based on the BAWSCA Long-Term Reliable Water Supply Strategy Phase I Scoping Report (Table A-2, May, 2010) with adjustments for active conservation.
(6) Projections are consistent with the City of San Jose Envision 2040 Draft General Plan Update Preferred Alternative. Includes all of San Jose Municipal's service areas and portions of Coyote Valley where the actual retailer to serve this area has not yet been defined.
(7) Demands for independent pumpers were assumed to continue at the same average level observed in the historical pumping record (2000 – 2009).
(8) Calculated from estimates of projected total agricultural acreage and a water use factor (1.7 AF/yr).

3.4.5.1 Future Loading from Landscape and Agricultural Irrigation

To determine future loading from landscape and agricultural irrigation, the retailer demand projections listed in Table 36 were apportioned to each retailer according to the in-basin/out-basin use splits, indoor-outdoor use splits, and water sources splits (groundwater, treated imported water, SFPUC water, and/or local reservoir water) described in Section 3.3.1.7. The

period from 2010–2015 is not addressed in the UWMP projections shown in Table 36. The large increase in loading from 2010–2015 shown in Figure 22 is due to extrapolating from the 2010 measured values to the volume for the projected 2015 retailer demand. This suggests that the retailer demand projected in the 2010 UWMP for 2015 and possibly subsequent years is overestimated. During the 2013-2014 drought, landscape irrigation has declined, rather than increased. Drought conservation measures are not reflected in the projections because the analysis was based on the 2010 UWMP projections.

Agricultural water demand projections shown in Table 36 apply primarily to the Llagas Groundwater Subbasin. The percent change for each five-year interval was applied to the agricultural acreages in the Santa Clara Plain and Coyote Valley. Figures 22-25 chart the projected loading from landscape irrigation by retailer water and agricultural wells, domestic wells and other supply wells used to irrigate parks, golf courses, cemeteries, etc. (non-retailer irrigation).

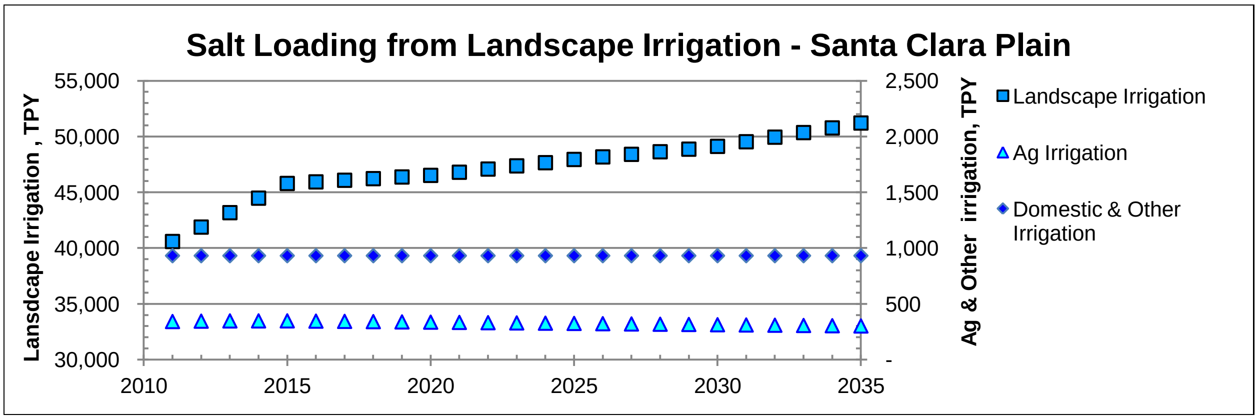


Figure 22 – Salt Loading from Landscape and Agricultural Irrigation in the Santa Clara Plain

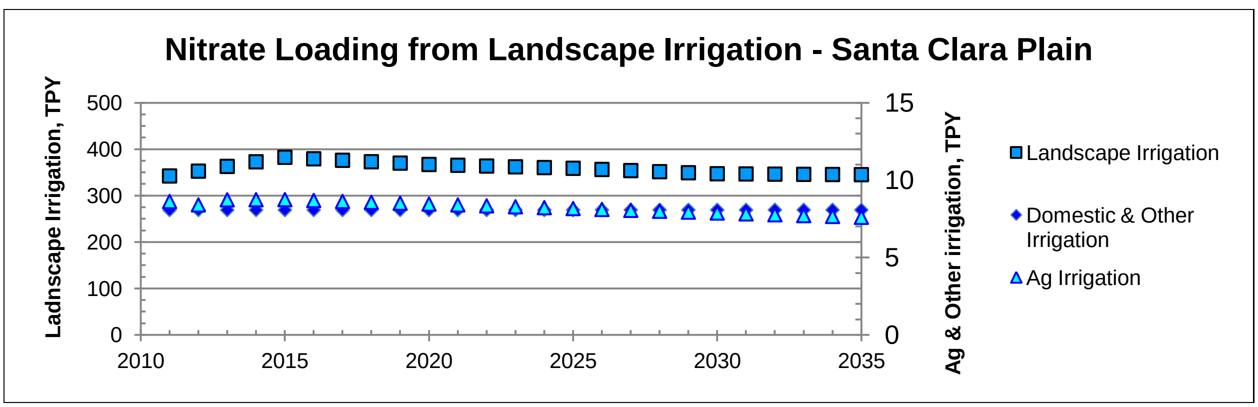


Figure 23 – Nitrate Loading from Landscape and Agricultural Irrigation in the Santa Clara Plain

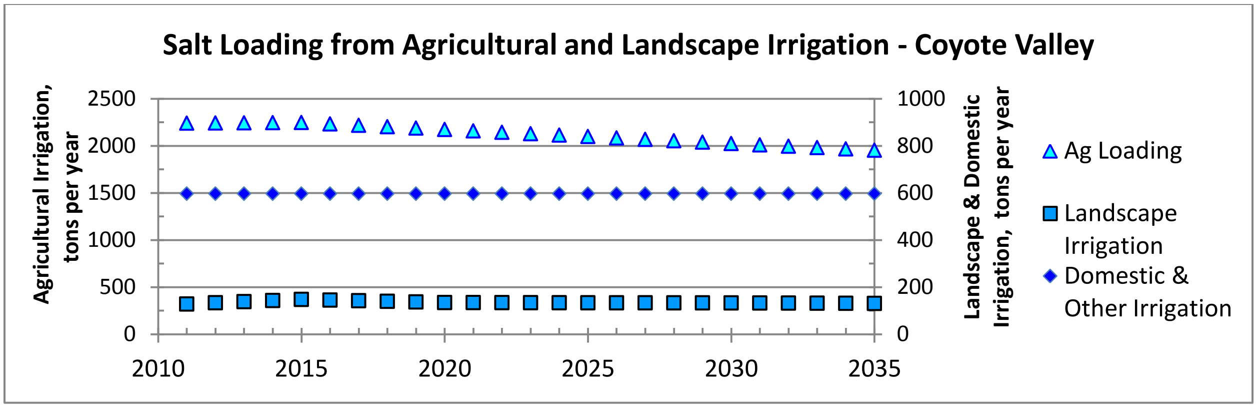


Figure 24 – Salt Loading from Landscape and Agricultural Irrigation in the Coyote Valley

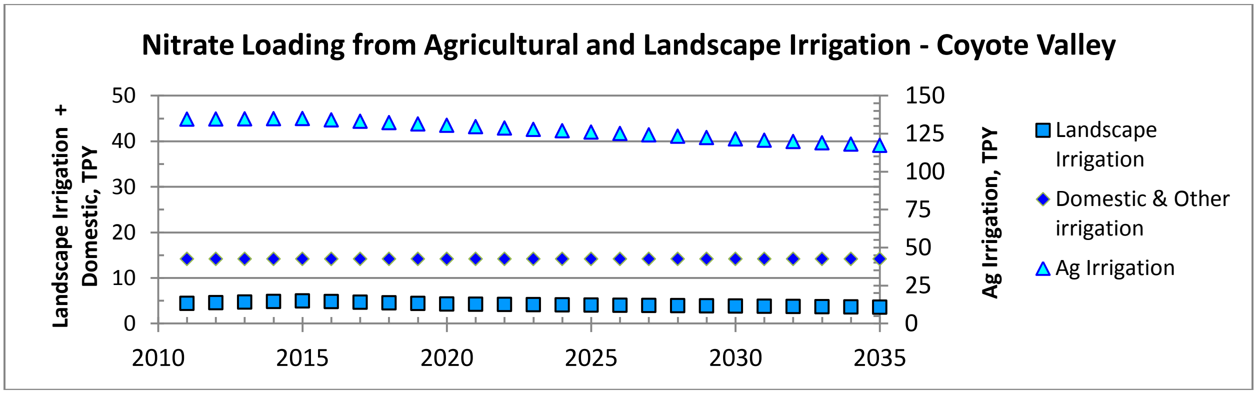


Figure 25 – Nitrate Loading from Landscape and Agricultural Irrigation in the Coyote Valley

3.4.5.2 Future Loading from Natural and Managed Recharge

Projections for natural recharge are held constant for the planning horizon as mountain-front recharge and basin inflow are assumed to remain the same. Projected increases in managed recharge are based on capital projects included in the District's 5-year Capital Improvements Projects Plan that will increase operational recharge capacity to the extent that water supply is available. The 2012 Water Supply Infrastructure Master Plan also identifies a new recharge facility in the western Santa Clara Plain. For the purposes of this SNMP, the capacities of the improvements and increased recharge volumes assumed to come on-line according to the schedule are shown in Table 38.

Table 38 – Schedule and Capacity of Recharge Capital Improvement Projects

Project	Average Yield Increase Capacity, AF/yr	Assumed Increase in Recharge, AF/yr	Estimated Completion Date
Alamitos Diversion Dam	2,200	440	2018
Coyote Diversion Dam	5,000	1,000	2020
Kirk Diversion Dam	4,600	920	2015
New Recharge Facility	3,300	1,650	2026
TOTALS	**15,100**	**4,010**	

Managed recharge is also projected to increase as Indirect Potable Reuse (IPR) projects come on-line. IPR projects take advanced treated recycled water blended with current sources of recharge to provide lower TDS water for recharging the subbasin. The assumed quality of water supplied with IPR projects is 168 mg/L TDS and 2 mg/L nitrate as NO_3. Actual quality of water used for IPR may have higher or lower concentrations depending on operational constraints and other factors. The assumed schedule of increased recharge volumes from IPR projects is as follows:

Table 39 – Schedule and Capacity of Indirect Potable Reuse Recharge Projects

Project	Average Yield Increase (AF/yr)	Estimated Completion Date
Los Gatos Recharge System	20,000 AF/yr	2032

Schedule and volumes included in the 2012 Water Supply Infrastructure Master Plan (SCVWD, 2012).

Water supply for recharge projects is highly variable due to its dependency on available imported water and rainfall-supplied local reservoirs. The baseline volumes for managed recharge are based on the sum of recharge facility 10-year median volumes. The range of managed recharge volumes from 2001 through 2010 is from 64,629 to 88,507 AF/yr. The projected salt and nitrate loading from managed recharge shown below in Figures 26-29 includes managed recharge in percolation ponds and creeks.

A significant source of variability in recharge water quality is the quality of water imported from the state and federal water projects and used in recharge operations. Depending on how current and/or future pumping facilities in the Sacramento/San Joaquin delta are operated, overall salinity (TDS) of imported water may decrease between 50 and 100 mg/L. If no changes are made to delta operations and severe climate change scenarios are realized, imported water salinity may increase substantially. Because both scenarios (improved or deteriorated delta water quality) are highly uncertain, the projections for SNMP have held imported water TDS and nitrate constant by water source.

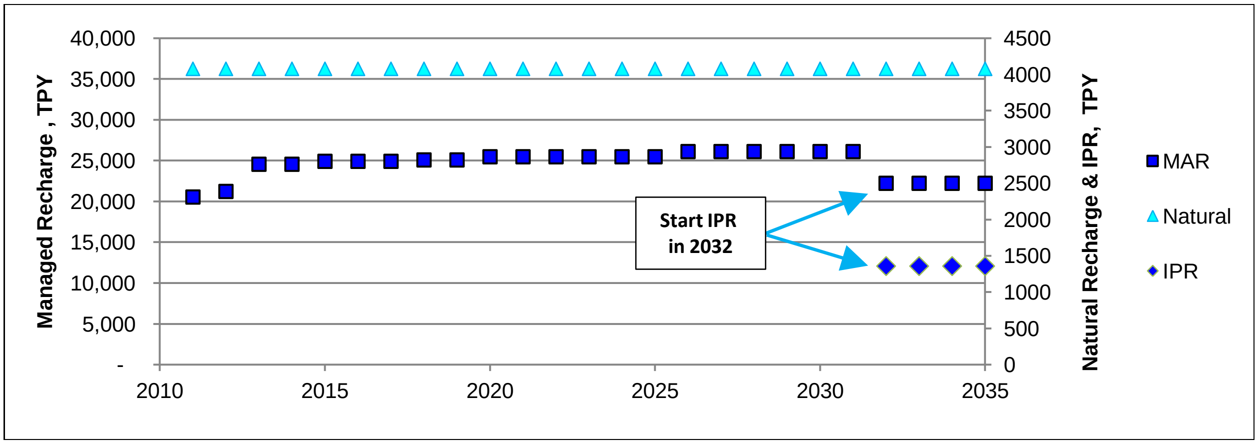


Figure 26 – Salt Loading from Managed Recharge, Natural Recharge, and Indirect Potable Reuse in the Santa Clara Plain

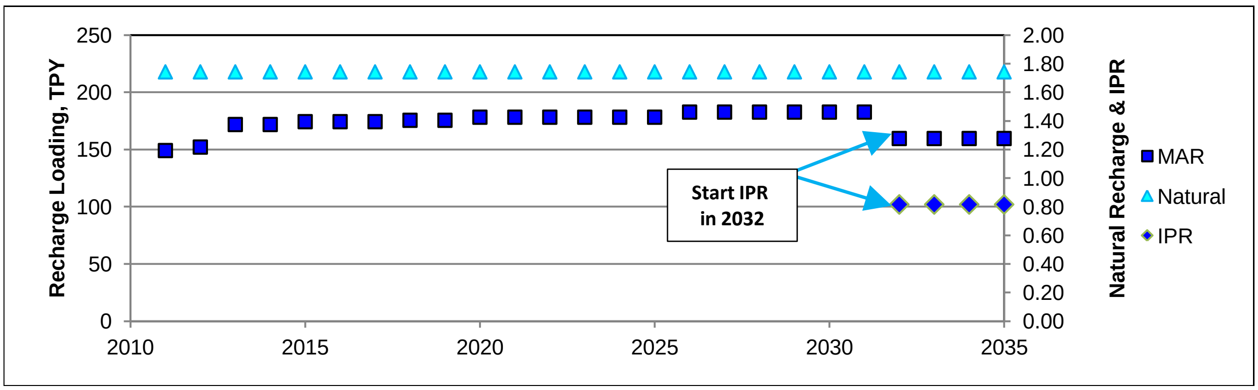


Figure 27 – Nitrate Loading from Managed Recharge, Natural Recharge, and Indirect Potable Reuse in the Santa Clara Plain

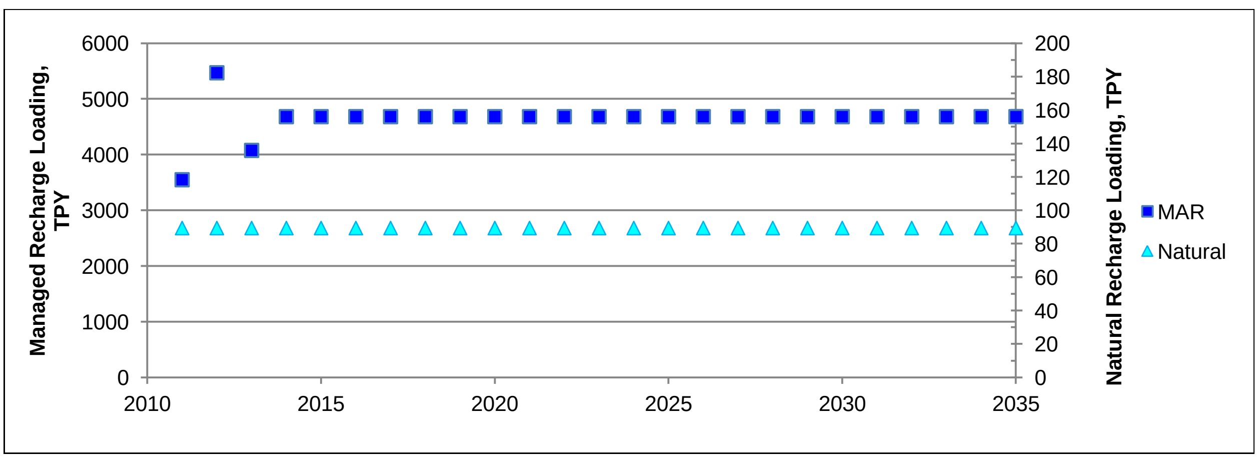


Figure 28 – Salt Loading from Natural and Managed Recharge in the Coyote Valley

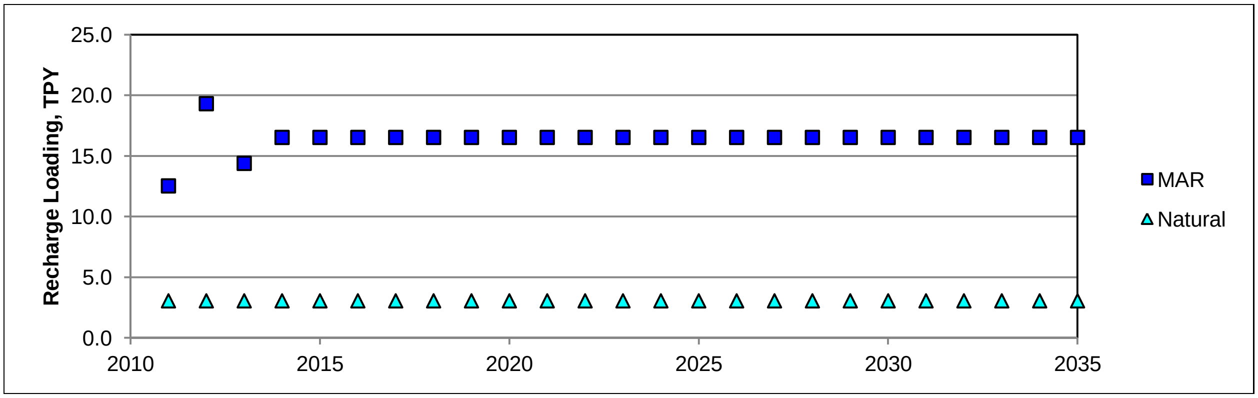


Figure 29 – Nitrate Loading from Natural and Managed Recharge in the Coyote Valley

3.4.5.3 Future Loading from Recycled Water

Future loading projections for recycled water include improved water quality from advanced treatment of recycled water, sewer line rehabilitation, and increased utilization of recycled water. Recycled water master plans were reviewed for each of the three producers (South Bay Water Recycling (SBWR), Sunnyvale Water Pollution Control Plant (WPCP), and Palo Alto Regional Water Quality Control Plant (PARWQP). The planned schedule of improvements and expansion used for SNMP projections are listed in Table 40.

Table 40 – Recycled Water Master Plans: Expansion and Water Quality Improvements

System	Volume Increases	Future TDS	Starting Year	Notes
SBWR	0	500 mg/L	2014 – 2017	Silicon Valley Advanced Water Purification Center comes on-line; tertiary treated recycled water blended with purified water to lower TDS from 725 mg/L to 500 mg/L, phased in system-wide by 2017; assume linear change.
SBWR	4,850	500 mg/L	2015 – 2035	SJWC UWMP baseline + projected 4,850 AF/yr new SJWC projects in next 25 yrs; add 970 AF/yr every 5 yrs.
SBWR	3,300	500 mg/L	2020 – 2035	SJ UWMP baseline + projected 3,300 AF/yr new RW SJ Muni. RW projects; adding 825 AF/yr every 5 yrs in 2020.
SBWR	100	500 mg/L	2020	Adds 100 AF/yr for Milpitas BART Station development in 2020.
SVWPCP	1,885	760 mg/L	2020 – 2033	Treatment improves TDS from 856 mg/L TDS to 760 mg/L in 2023. Increased volume from Apple and other expansion; 495 AF/yr by 2020; 764 AF/yr by 2025; 140 AF/yr by 2030; 486 AF/yr by 2030.
PARWQCP	0	770 mg/L – 600 mg/L	2013 – 2018	PARWQCB resleeved a sewer main in Mtn. View producing immediate improvement to TDS by eliminating saline groundwater intrusion. Additional resleeving projects are planned to bring TDS to 600 mg/L by 2018.
PARWQCP	5,500	600 mg/L	2027	Palo Alto Phase III recycled water expansion projects 5,500 AF/yr increase by 2027. Up to 915 AF/yr additional expansion may occur in current Phase II, which is not yet serving at full capacity.

The quality of source water before it becomes wastewater and recycled water varies significantly under different scenarios. As mentioned in 3.3.5.2, TDS in imported water may increase or decrease, depending on whether improvements are made to managing delta pumping and whether climate change scenarios are realized. Changes to source water quality can shift the quality of recycled water, depending on the type and degree of treatment. The future projections for recycled water reflect planning scenarios only, and exclude delta conveyance improvements and climate change scenarios. Groundwater quality also changes in response to loading and removal, so the source water that becomes recycled water may change as groundwater quality changes or as the blend of supplies shifts. These potential variations in recycled water quality are not incorporated into the future planning scenarios evaluated here.

The schedule of planned improvements is also subject to change. For example, the PARWQCP Long Range Facilities Plan calls for addition of reverse osmosis and micro-filtration by 2050, but changing conditions could lead to bringing advanced treatment online sooner, possibly within the SNMP planning horizon. Similarly, planned improvements for SBWR and Sunnyvale WPCP could come on-line earlier or later than the SNMP planning scenarios. Figures 22 and 23 display the projected loading from recycled water in the scenario outlined in Table 40.

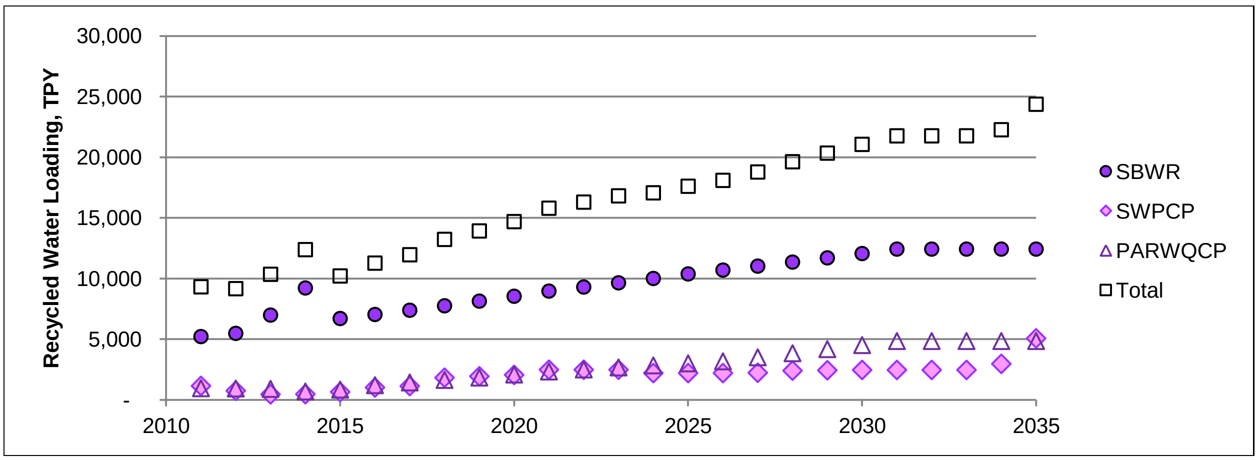


Figure 30 – Salt Loading from Recycled Water in the Santa Clara Plain

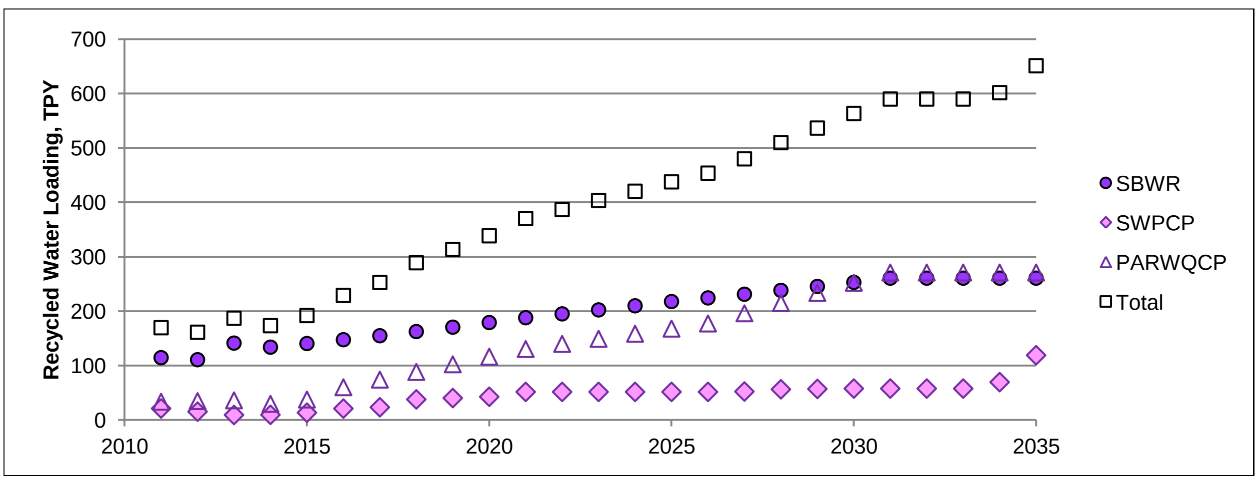


Figure 31 – Nitrate Loading from Recycled Water in the Santa Clara Plain

Notes: SBWR = South Bay Water Recycling; SWPCP = Sunnyvale Water Pollution Control Plant; PARWQCP = Palo Alto Water Pollution Control Plant.

3.4.5.4 Future Loading from Conveyance and Drainage Losses

As described in 3.3.1.9 and 3.3.1.10, conveyance losses include that portion of water distribution system losses that ultimately recharge groundwater. Similarly, drainage losses are losses from storm drains, sewer lines, and septic leachfield effluent that recharge groundwater. Conveyance losses are treated as proportional to the volume of water served, and indexed to projected changes in annual total volume of water served by water retailers inside the Santa Clara Plain or inside the Coyote Valley (including the portion of Morgan Hill that is in Coyote Valley).

Storm drain losses are proportional to future volumes of runoff. To make an approximation, storm drain losses are indexed to population growth, which is taken as an indicator of the increase in impervious surfaces. Assuming that most new development is multi-family housing, the percent increase in impervious surface area was taken as the percentage of population increase.

Septic leachfield volumes are assumed to remain constant. The County's new Onsite Wastewater Treatment System (OWTS) Ordinance could lead to some improvements in septic tank management, potentially decreasing loading from this source. The impacts of the ordinance are subject to many variables that are not easily assessed, so a constant value was used.

Sewer line losses are indexed to the SCVWD 2010 Urban Water Management Plan projections for wastewater treatment flows to obtain volume increases. Wastewater concentration is indexed to measured values from 2010, which increase as a result of water conservation. Indoor water conservation results in increased TDS concentration of influent at wastewater treatment plants which can negatively impact the quality and quantity of recycled water. The degree to which wastewater concentration changes in response to water conservation is unknown; however this effect is widely observed (Wistrom, et al., 2006). An assumption is made that wastewater TDS concentration increases by 1/10th the amount of projected increases in water conservation volumes. Table 41 summarizes the assumptions made for sewer line loss projections. Figure 32 displays loading projections from conveyance losses in the Santa Clara Plain, and Figures 33 and 34 provide loading projections for drainage losses in the Santa Clara Plain. Both conveyance losses and drainage losses in Coyote Valley are small and fixed at constant values throughout the 25-year period evaluated.

Table 41 – Factors Used to Project Future Sewer Line Losses

Year	2015	2020	2025	2030	2035
Wastewater Volume, MGD	169	177	184	192	194
Percent WW Volume change	4.5%	4.7%	4.0%	4.3%	1.0%
Conservation Goal, AF/yr	63,100	76,100	86,700	98,800	98,800
Concentration Increase % (assumed)	2.47%	2.06%	1.39%	1.36%	0.0%

Source: SCVWD 2010 Urban Water Management Plan

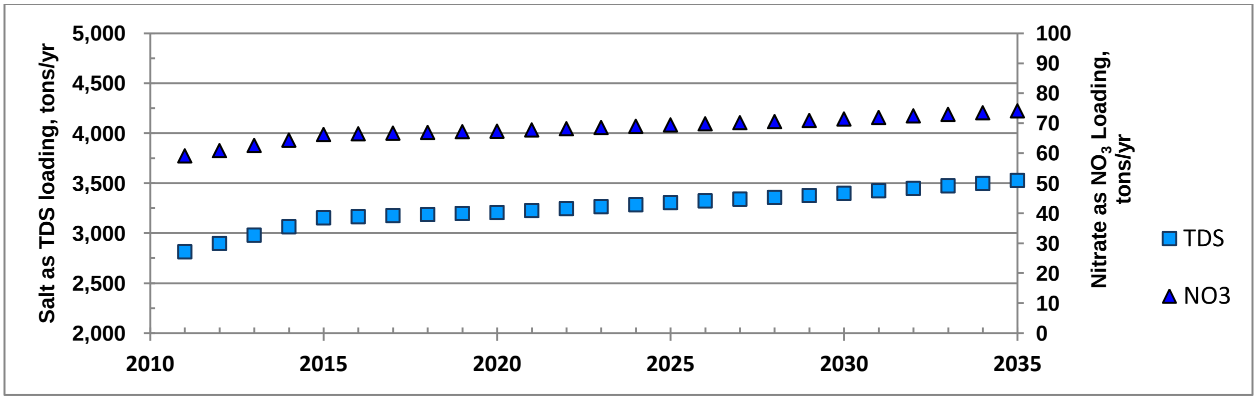


Figure 32 – TDS and Nitrate Loading from Conveyance Losses in the Santa Clara Plain

Note: conveyance losses in Coyote Valley are small (ranging from 12 to 15 tons per year TDS and 0.4 to 0.5 tons per year nitrate), and are therefore not displayed. Nitrate as NO_3 is displayed on the right axis.

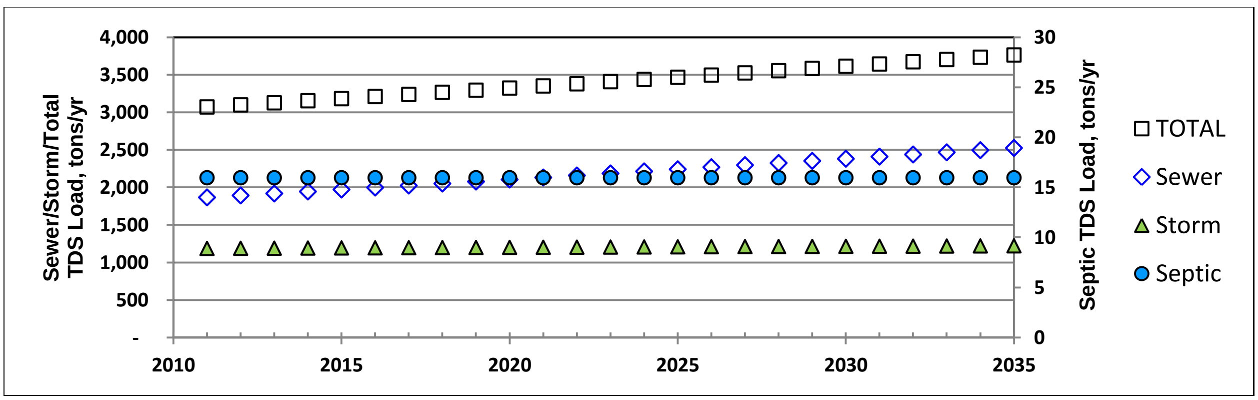


Figure 33 – TDS Loading from Drainage Losses in the Santa Clara Plain

Note: Nitrate as NO3 loading from drainage losses (septic tanks) in Coyote Valley are held constant throughout the planning period (127 tons TDS per year), and are therefore not displayed.

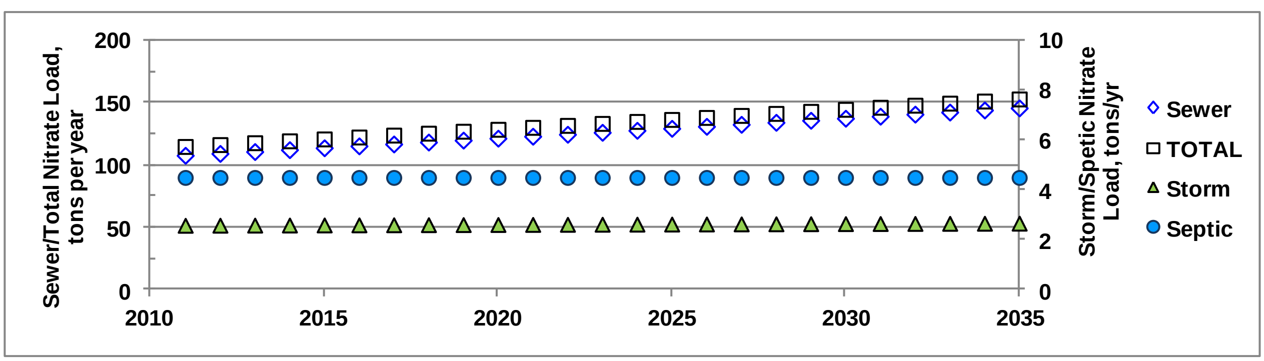


Figure 34 – Nitrate as NO3 Loading from Drainage Losses in the Santa Clara Plain

Note: Nitrate as NO3 loading from drainage losses (septic tanks) in Coyote Valley are held constant throughout the planning period (79 tons nitrate as NO_3 per year), and are therefore not displayed.

3.4.5.5 Future Loading from Dry Loading Sources

Dry loading includes fertilizer, soil amendment application, and atmospheric deposition. Combined, these categories contribute only minor amounts of salt and nitrate. The factors that could change rates of fertilizer use or rates of atmospheric deposition are not quantified. Atmospheric deposition could decrease in response to more alternative fuel vehicles and improved emissions controls, and fertilizer application could decrease with land use changes. Because these changes are not easily predicted, for SNMP analysis, they were left as fixed values equal to the 2001-2010 median loading rates.

3.4.5.6 Salt and Nitrate Removal Projections

As listed in Table 15 and shown in Figure 15, salt and nitrate are removed when groundwater is removed by pumping, basin outflow, gaining reaches of streams, and groundwater infiltration into sewer lines and storm drains. The primary variable in salt and nitrate removal is the rate of groundwater pumping. Projected demand by water source was obtained from the Urban Water Management Plans and pro-rated to annual increments to project rates of salt and nitrate removal due to groundwater pumping. Infiltration of saline groundwater to sewer lines has been reduced in Palo Alto and additional projects will further reduce infiltration. Gaining reaches of streams in the Santa Clara Plain have not been quantified; though there might be some groundwater discharging to streams in the northern reaches of streams. Figures 35-38 summarize the projected rates of salt and nitrate removal.

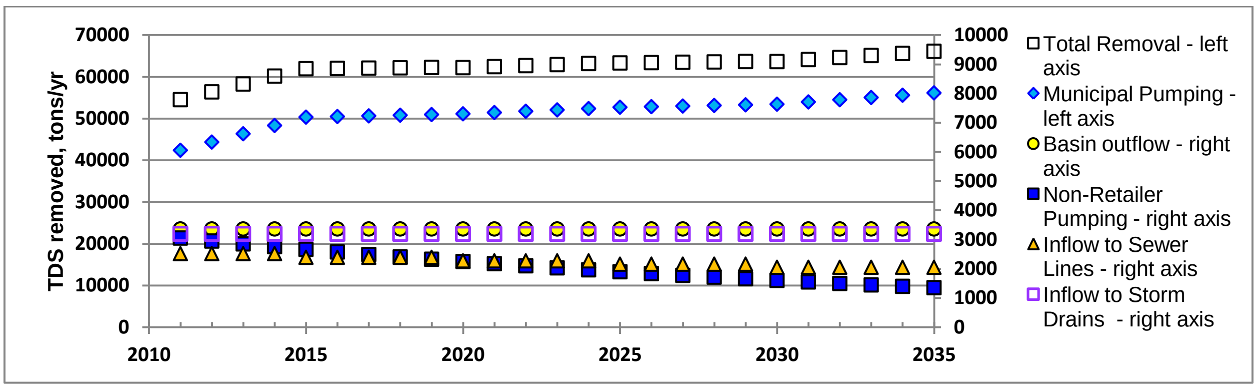


Figure 35 – TDS Removal in the Santa Clara Plain

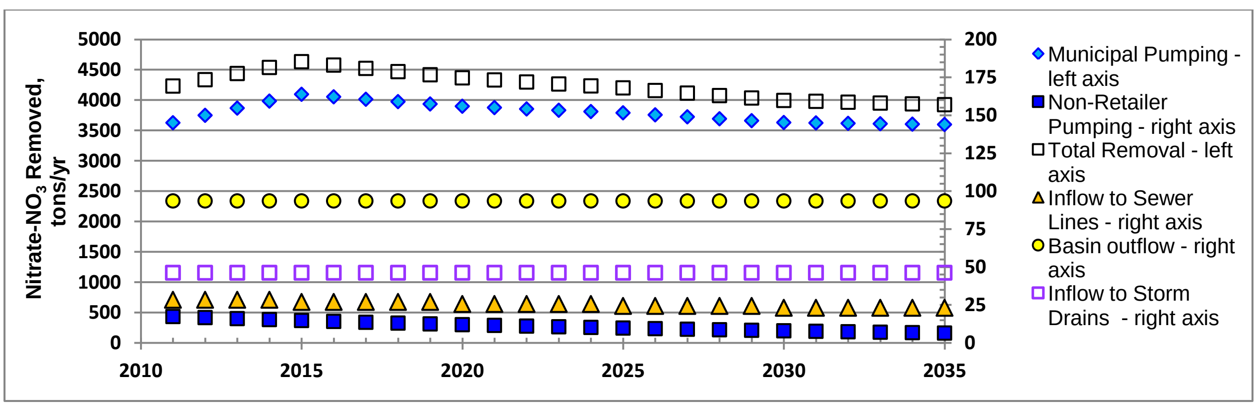


Figure 36 – Nitrate as NO3 Removal in the Santa Clara Plain

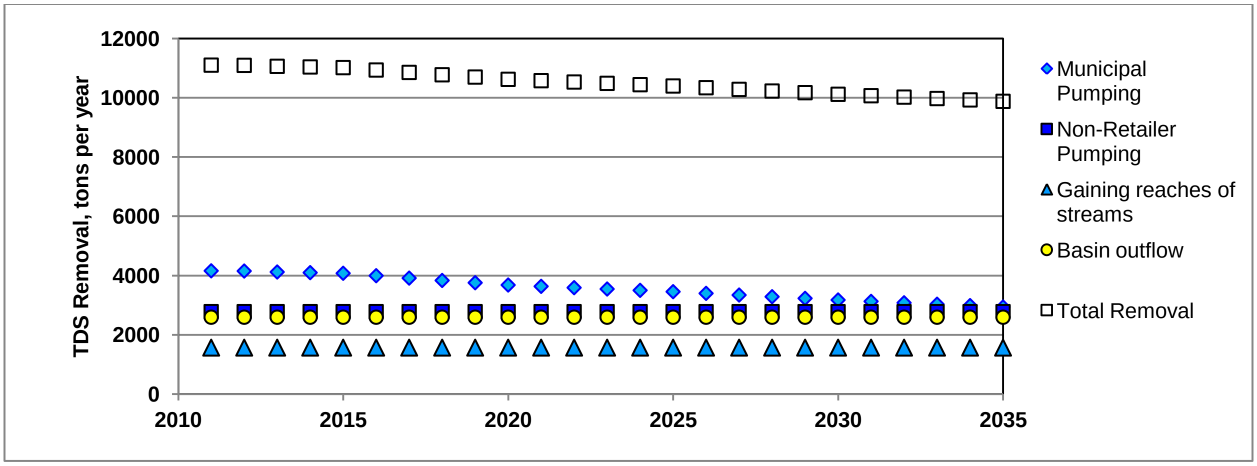


Figure 37 – TDS Removal in the Coyote Valley

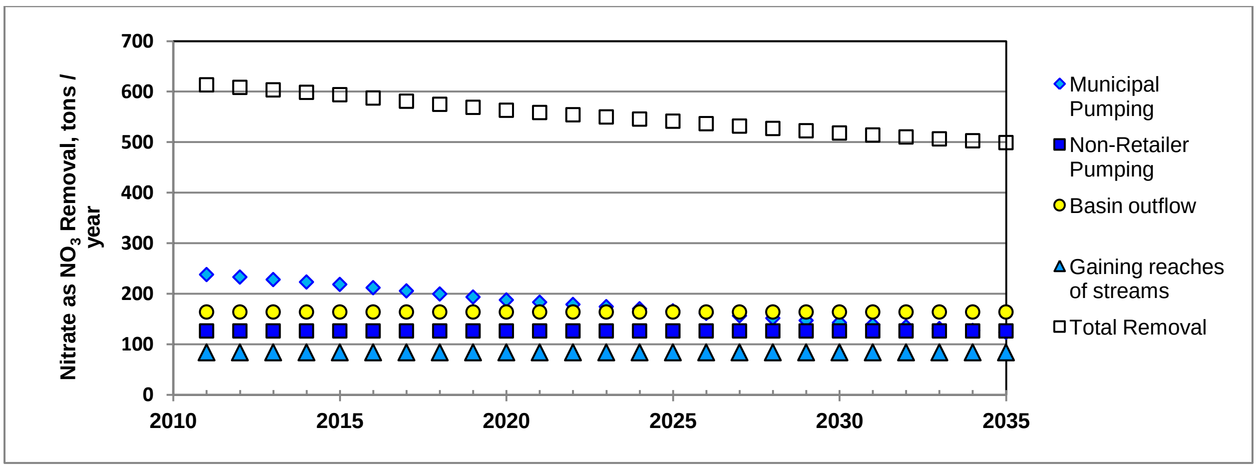


Figure 38 – Nitrate as NO_3 Removal in the Coyote Valley

3.4.5.7 Net Loading/Removal and Assimilative Capacity

The sum of all loading projections, minus the sum of all removal projections, gives the net loading or removal. In the Santa Clara Plain, net loading of TDS is projected to start at 25,000 tons per year and grow to 47,000 tons per year by 2035. The primary causes of the net loading are outdoor irrigation, imported water used for groundwater recharge, and increasing irrigation with recycled water. Currently, about 90,000 AF of water is imported and used in the Santa Clara Groundwater Subbasin for outdoor irrigation and managed aquifer recharge. Imported water used outdoors or for recharge represents about 26,000 tons of new salt per year (TDS), with about 7,000 tons salt added to groundwater through recharge, and about 19,000 tons salt added through landscape irrigation.[25] Nitrate addition from imported water is low due to the low concentration of nitrate found in imported water. Concurrent with the addition of 26,000 tons of salt to groundwater per year from imported water, groundwater is removed from the subbasin via groundwater pumping and basin outflow. Pumping and basin outflow remove a combined 49,000 tons of salt per year. The TDS in water served by municipal retailers is returned to the

[25] These figures exclude imported water used for outdoor irrigation at homes and businesses located in the foothills outside the groundwater Subbasin. Imported Water refers to State Water Project, Federal Water Project water from the San Luis Division, and Hetch-Hetchy water from the San Francisco Public Utilities Commission.

groundwater basin at an average rate of about 45% (the percentage of municipal water used for outdoor irrigation), while about 55% of the salt goes to the wastewater treatment plants and to the Bay, with a small fraction getting processed as recycled water. The nitrate in imported water is much lower than in groundwater, so groundwater pumping combined with root uptake and denitrification, cause a net removal of nitrate from the groundwater basin.

While the amount of new salt introduced to the subbasin each year is large, the volume of water into which the salt is mixed in this analysis is also large. Table 34 presents the mixing volume – 25,746,900 AF. The starting net loading amount in 2011, tons per year when divided by the mixing volume equates to a net change in TDS concentration of 0.88 mg/L per year. By 2035, the net loading is projected to increase to 47,000 tons per year, producing a net change in TDS concentration of 1.31 mg/L/yr.

To determine future estimated basin concentrations, the net loading is added to the mass of salt already dissolved in groundwater at ambient concentrations. The overall basin average TDS concentration calculated in Section 3.3.2 is 425 mg/L. The existing mass of salt dissolved in groundwater is 17,260,184 tons. The net loading forecasted for each year is added to the prior year's total salt mass and divided by the basin saturated porosity volume to get the next year's concentration. The new concentration is used to determine net removal from groundwater pumping and net loading from landscape irrigation with groundwater. Figures 39-42 show the net loading, future TDS and nitrate concentrations, and corresponding assimilative capacity. The fluctuation in net loading is due to use of actual recharge volumes for 2010–2012 and projected 2013 based on January-October data.

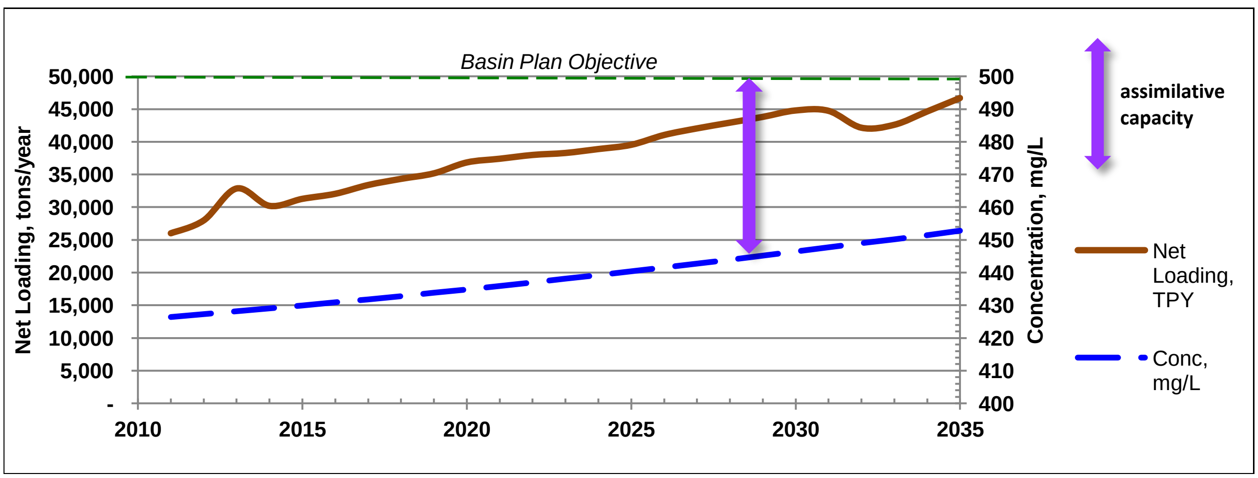


Figure 39 – Net TDS Loading and Projected Average TDS Concentrations in the Santa Clara Plain

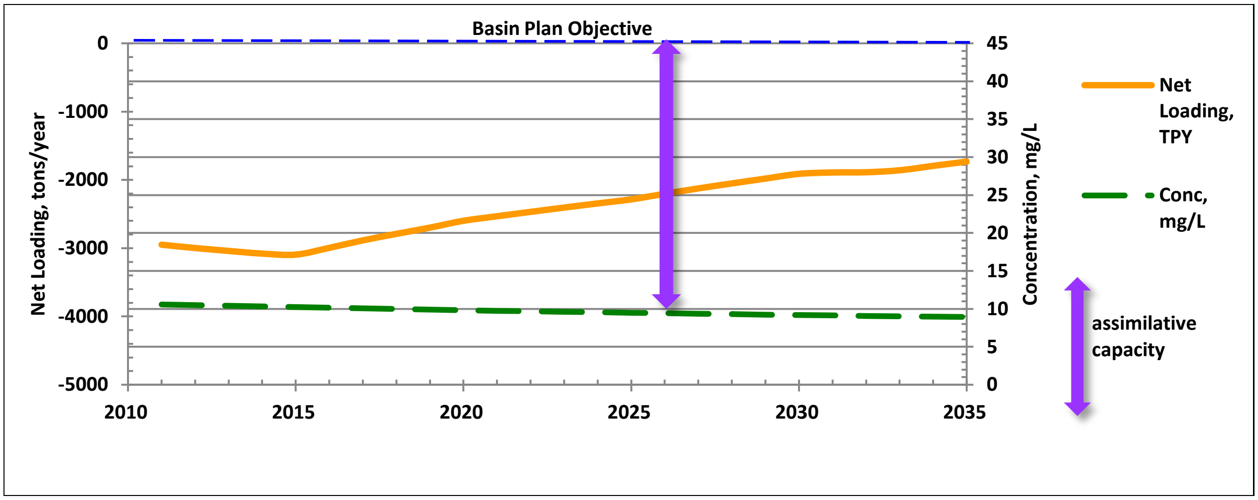


Figure 40 – Net Nitrate as NO3 Loading and Projected Average NO3 Concentrations in the Santa Clara Plain

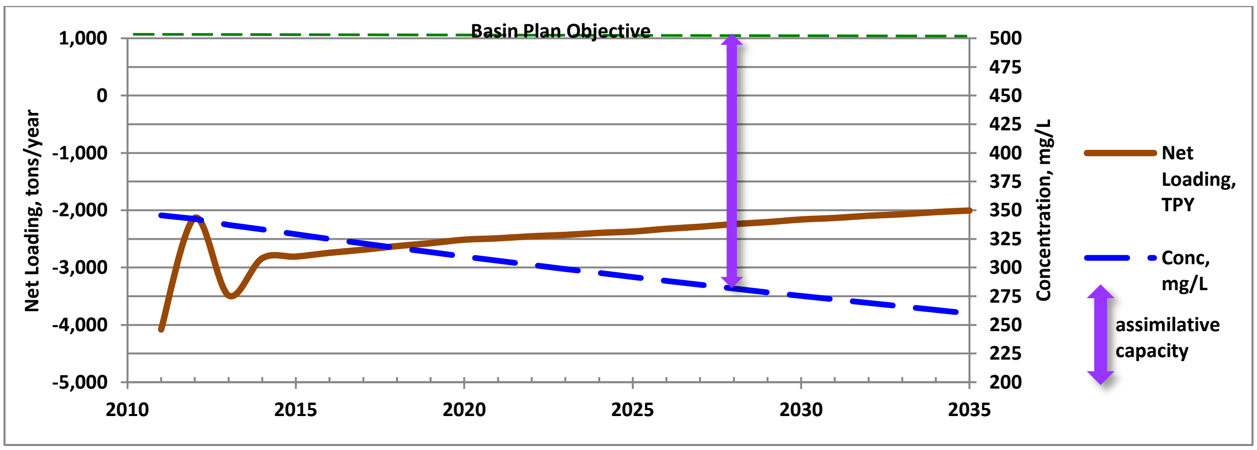


Figure 41 – Net TDS Loading and Projected Average TDS Concentrations in the Coyote Valley

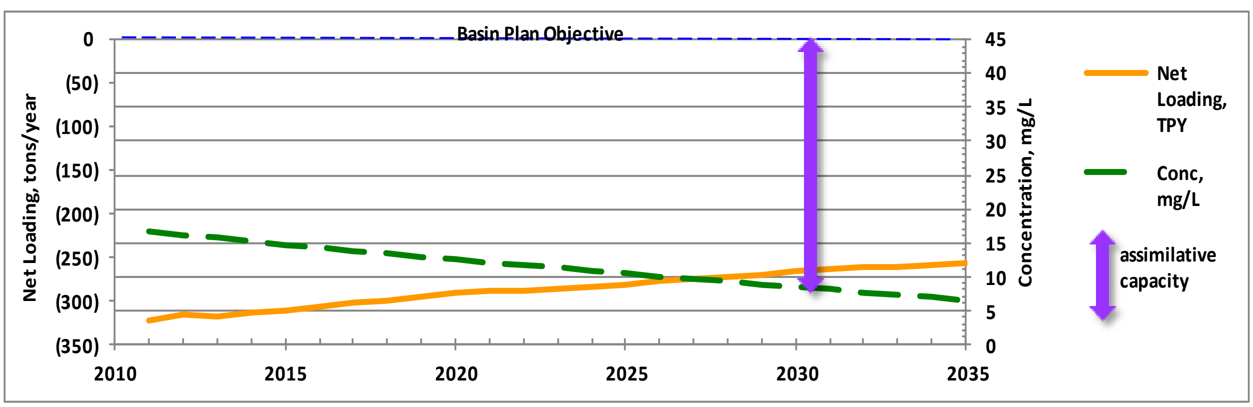


Figure 42 – Net Nitrate as NO3 Loading and Projected Average NO3 Concentrations in the Coyote Valley

The net removal of both TDS and nitrate in Coyote Valley is partly attributable to pumping that supplies water to consumers in the Santa Clara Plain, i.e., the water is moved from one subarea to the other (about 3,100 tons per year TDS and 86 tons per year nitrate as NO_3). There is also a net basin outflow from Coyote Valley, about 2,500 tons per year TDS and 160 tons per year nitrate. In addition, Coyote Valley has gaining reaches of streams that remove about 1,700 tons per year TDS and about 110 tons per year nitrate. The net removal of salt and nitrate produces a steady decrease in estimated concentrations as shown in Figures 41 and 42, above.

3.4.5.8 Allocation of Future Assimilative Capacity

The allocation of future assimilative capacity consumption by loading category is listed in Table 42. The sum of all planned recycled water irrigation and groundwater recharge projects in the Santa Clara Plain consumes 9.2% of the TDS assimilative capacity in the 25 year planning timeframe ending in 2035. The assimilative capacity of nitrate as NO_3 is projected to increase due to net nitrate removal from groundwater pumping, basin outflow, and sewer line infiltration; therefore, recycled water projects do not consume any assimilative capacity for nitrate as NO_3.

At the end of the 25 year evaluation period in 2035, 41% of the 75 mg/L TDS assimilative capacity is projected to be consumed overall (30.75 mg/L), with 44.25 mg/L TDS assimilative capacity remaining. The TDS assimilative capacity consumed by all planned Santa Clara Plain recycled water projects (including landscape irrigation and indirect potable reuse), 6.3%, is below the Recycled Water Policy 20% threshold for multiple projects.

Table 42 – Annual Consumption of TDS Assimilative Capacity (AC) by Loading Categories

	% AC Consumed overall	% AC by Recycled Water	% AC by Managed Recharge	% AC by Indirect Potable Reuse	% AC by Irrigation (excludes recycled water)	% AC by Natural Recharge Drainage + Conveyance & Dry Loading
2011	1.29%	0.12%	0.33%		0.67%	0.17%
2012	1.25%	0.12%	0.32%		0.64%	0.16%
2013	1.43%	0.16%	0.39%		0.70%	0.18%
2014	1.41%	0.16%	0.38%		0.70%	0.17%
2015	1.42%	0.16%	0.38%		0.71%	0.17%
2016	1.42%	0.16%	0.38%		0.71%	0.17%
2017	1.42%	0.16%	0.38%		0.71%	0.17%
2018	1.46%	0.17%	0.38%		0.72%	0.18%
2019	1.49%	0.19%	0.39%		0.73%	0.18%
2020	1.54%	0.20%	0.40%		0.75%	0.18%
2021	1.57%	0.22%	0.41%		0.76%	0.18%
2022	1.59%	0.23%	0.41%		0.77%	0.19%
2023	1.61%	0.24%	0.41%		0.77%	0.19%
2024	1.64%	0.25%	0.41%		0.78%	0.19%
2025	1.67%	0.26%	0.42%		0.79%	0.19%
2026	1.72%	0.28%	0.43%		0.81%	0.19%
2027	1.76%	0.29%	0.44%		0.82%	0.20%
2028	1.79%	0.31%	0.44%		0.83%	0.20%
2029	1.82%	0.32%	0.45%		0.85%	0.20%
2030	1.86%	0.34%	0.45%		0.86%	0.20%
2031	1.85%	0.34%	0.45%		0.86%	0.20%
2032	1.76%	0.35%	0.37%	0.023%	0.84%	0.20%
2033	1.75%	0.35%	0.37%	0.022%	0.84%	0.20%
2034	1.75%	0.34%	0.36%	0.022%	0.84%	0.20%
2035	1.75%	0.34%	0.36%	0.022%	0.84%	0.20%
TOTAL	**41.3%**	**6.2%**	**10.2%**	**0.1%**	**20%**	**4.8%**

CHAPTER 4: SALT AND NUTRIENT MONITORING PLAN

The Recycled Water Policy requires development of a SNMP Monitoring Plan for each groundwater basin in California. The District is the groundwater management agency for Santa Clara County, which includes the Santa Clara Groundwater Subbasin. For many years the District has conducted regular comprehensive monitoring that includes TDS and nitrate, as well as other water quality parameters. The District also analyzes data from municipal wells reported to DDW. The District prepares annual water quality reports that document the monitoring results and provides trend analyses for TDS and nitrate, and a comparison of detections with WQOs. District monitoring reports are made available on its website.

The proposed SNMP Monitoring Program includes the District's voluntary subbasin monitoring and reporting for TDS and nitrate. The District currently conducts monitoring for selected CECs at a recycled water irrigation site. CEC monitoring is not a required component of the Recycled Water Policy for basins where recycled water reuse is limited to irrigation (there are currently no active recycled water recharge projects). The District's ongoing groundwater monitoring and reporting is voluntary and relies on monitoring District monitoring wells and private wells under agreements with the well owners.

The Salt and Nutrient Monitoring Plan, provided as Appendix 3, is a subset of the District's regional monitoring program, which covers more water quality parameters than are required by the Recycled Water Policy. The goals established in the Recycled Water Policy for the Salt and Nutrient Monitoring Plan are met by the District's annual sampling. Monitoring well locations coincide with recharge locations, recycled water operations, and groundwater production. The plan presented in Appendix 3 fulfills the objectives set forth in the Recycled Water Policy.

CHAPTER 5: ANTI-DEGRADATION ANALYSIS

The regional and cumulative impacts analysis presented in Chapter 3 of this SNMP demonstrates that multiple recycled water projects in the Santa Clara Groundwater Subbasin use a minor amount of the available TDS assimilative capacity. The analysis shows that assimilative capacity is expected to increase (i.e., concentrations are projected to decline) for both nitrate and TDS in the Coyote Valley, and for nitrate in the Santa Clara Plain. Groundwater TDS concentrations are projected to increase in the Santa Clara Plain by 2035, but are not projected to exceed the Basin Plan objective. Chapter 3 demonstrates that the minority of the projected Santa Clara Plain TDS increase is attributable to recycled water irrigation.

As noted in Chapter 3, the simplifying assumptions made for this SNMP (e.g., instantaneous mixing, no attenuation of salts in the unsaturated zone) have the effect of overstating the rate of salt accumulation. For example, the concentration trends associated with future projections are not mirrored in observed trends from the last 15 years, yet the same S/N loading and removal processes have been ongoing.

The District has invested in the Silicon Valley Advanced Water Purification Center (SVAWPC) to substantially improve recycled water quality. The District and water retailers are engaged in a continuous effort to increase water conservation, which can further reduce the amount of salt loading. The Bay Delta Conservation Plan, if implemented, could also play a major role in reducing the importation and accumulation of salt. As improvements are made to limit conveyance losses and drainage losses and to increase outdoor water conservation, the rate of salt accumulation will slow. Similarly, employing micro-irrigation technologies and limiting fertilizer use to agronomic demands will help to reduce S/N loading.

The Recycled Water Policy and other statewide planning documents recognize the tremendous need for and benefits of increased recycled water use in California. As stated in the Recycled Water Policy, *"The collapse of the Bay-Delta ecosystem, climate change, and continuing population growth have combined with a severe drought on the Colorado River and failing levees in the Delta to create a new reality that challenges California's ability to provide the clean water needed for a healthy environment, a healthy population and a healthy economy, both now and in the future."* As the policy notes, *"We strongly encourage local and regional water agencies to move toward clean, abundant, local water for California by emphasizing appropriate water recycling, water conservation, and maintenance of supply infrastructure and the use of stormwater (including dry-weather urban runoff) in these plans; these sources of supply are drought-proof, reliable, and minimize our carbon footprint and can be sustained over the long-term."* With the current severe drought, the benefits of recycled water use in terms of sustainability and reliability cannot be overstated. Use of recycled water in the Santa Clara Groundwater Subbasin is consistent with the maximum benefit of the people of Santa Clara County.

The SNMP analysis finds that recycled water use can be increased while still protecting groundwater quality for beneficial uses. Table 43 provides an explanation of why recycled projects are in compliance with SWRCB Resolution No. 68-16.

Table 43 – Anti-Degradation Assessment

<table>
<tr><th>SWRCB Resolution No. 68-16 Component</th><th>Anti-Degradation Assessment</th></tr>
<tr><td>Water quality changes associated with proposed recycled water project(s) are consistent with the maximum benefit of the people of the State.</td><td rowspan="3">• The Basin Plan Water Quality Objectives are being met in average ambient groundwater and will continue to be met in the future
• Recycled water irrigation project(s) and other S/N loading sources will not cause average groundwater quality to exceed the SMCL for TDS or the primary MCL for nitrate-$NO_{3.}$
• Use of recycled water for irrigation to replace groundwater is consistent with the SWRCB Recycled Water Policy, which encourages increased reliance on local, drought-resistant water supplies.</td></tr>
<tr><td>The water quality changes associated with proposed recycled water project(s) will not unreasonably affect present and anticipated beneficial uses.</td></tr>
<tr><td>The water quality changes will not result in water quality less than prescribed in the Basin Plan.</td></tr>
<tr><td>The projects are consistent with the use of best practicable treatment or control to avoid pollution or nuisance and maintain the highest water quality consistent with maximum benefit to the people of the State.</td><td>• The recycled water used for irrigation is tertiary-treated water that meets California’s Title 22 unrestricted use classification.
• The District is now producing up to 8 MGD advanced treated water from the SVAWPC. The City of Sunnyvale Plans to improve recycled water quality, and the City of Palo Alto has resleeved some sewer mains resulting in lower TDS recycled water.</td></tr>
<tr><td>The proposed project(s) is necessary to accommodate important economic or social development.</td><td>• The recycled water projects are an integral part of water and wastewater master plans for the subbasin.</td></tr>
<tr><td>Groundwater management programs are being or will be implemented to continue attaining WQOs.</td><td>• The Santa Clara Groundwater Subbasin is actively managed with numerous programs, projects, and plans to manage groundwater, as described in Appendix 4.</td></tr>
</table>

CHAPTER 6: SUMMARY AND RECOMMENDATIONS

This SNMP tracks the addition and removal of salts and nutrients to and from the groundwater basin, revealing a dynamic interplay between water uses and salt accumulation and dilution. In the Coyote Valley, concentrations of both TDS and nitrate are found to decrease over time. In the Santa Clara Plain, nitrate concentrations are projected to decrease while TDS concentration is projected to increase, without exceeding basin water quality objectives. The rate of increase in TDS concentration does not correspond closely with the individual well TDS concentration trends analyzed in the District's annual groundwater reports. This suggests that the simplifying assumptions used to make the projections may be too aggressive, such that the projected rate of accumulation exceeds the measured concentration trends.

The categories contributing the greatest amount of S/N loading (outdoor irrigation of landscaping by potable water and managed recharge) are also linked to the largest means of S/N removal (groundwater extraction, consumptive uses of water, and basin outflow). Nevertheless, salt accumulation is indicated for the Santa Clara Plain, which warrants consideration of the following recommendations for additional salt and nutrient management measures:

1. New and continuing initiatives for outdoor water conservation will continue to diminish the quantities of S/N loading from outdoor irrigation with potable water.

2. New and continuing advanced treatment of recycled water will further reduce the minor amount of salt loading from this category.

3. If adopted and implemented, future indirect potable reuse with low TDS, advanced-treated recycled water can diminish the demand for imported water for managed recharge. Similarly, contingent on funding and approval, direct potable reuse of low TDS, advanced-treated recycled water finished at the District's drinking water plants can displace higher salinity groundwater and imported water currently distributed for indoor and outdoor water uses.

4. Adoption of the Bay Delta Conservation Plan is likely to significantly reduce the salinity of imported water used for both managed recharge and outdoor irrigation with potable water.

5. New and continuing city initiatives to improve sewer lines to prevent intrusion of saline groundwater will decrease salt loading from tertiary-treated recycled water used for irrigation.

6. Continued District monitoring and analysis of groundwater quality data will be useful for observing any changes to the long-term trends in TDS and nitrate in the Santa Clara Plain and Coyote Valley.

REFERENCES

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SNMP GLOSSARY

acre-foot – the amount covering one acre to a depth of one foot, equal to 43,560 cubic feet (325,850 gallons)

advanced treatment – treatment techniques such as microfiltration, reverse osmosis, and UV disinfection to produce highly-purified (near distilled quality) recycled water

anti-degradation analysis – an analysis to demonstrate that existing high quality water will be maintained, or that any change to existing water quality will be consistent with maximum benefit to the people of the State, will not unreasonably affect present and anticipated beneficial use of such water, and will not result in water quality less than that prescribed in the policies

aquitard – A layer of low-permeability soil (e.g. a clay) that retards but does not prevent the flow of water to or from an adjacent aquifer

assimilative capacity – the capacity for a water body to absorb constituents without exceeding a water quality objectives

bio-swale –landscape elements designed to remove silt and pollution from surface runoff water

confined aquifer – an aquifer that is overlain by a low permeability, confining layer, often made up of clay. The groundwater below the confining layer is under pressure greater than atmospheric and if penetrated with a well, the water level can rise above the top of the aquifer

constituents of emerging concern (emerging contaminants) – a broad range of unregulated chemical components found at trace levels in many of our water supplies, including surface water, drinking water, wastewater, and recycled water

conveyance losses – the combined volume of real losses from retailer distribution systems and regional transmission losses

denitrification – the microbially facilitated process of nitrate reduction that may ultimately produce molecular nitrogen (N2) through a series of intermediate gaseous nitrogen oxide products

disinfection byproducts – chemicals formed when disinfectants used in water treatment plants react with bromide and/or natural organic matter present in the source water. Disinfection byproducts for which regulations have been established fpr drinking water, include trihalomethanes, haloacetic acids, bromate, and chlorite

drainage losses – the combined quantity of water from sewer line exfiltration, storm drain exfiltration, and septic tank leach field effluent

effective porosity – the volume of pore space that will drain in a reasonable period of time under the influence of gravity

endocrine disruptors – chemicals that may interfere with the body's endocrine system and produce adverse developmental, reproductive, neurological, and immune effects in both humans and wildlife

gaining stream – a stream whose flow increases in the downstream direction due to the discharge of groundwater into the streambed

groundwater basin/subbasin – an area underlain by permeable materials capable of furnishing a significant supply of groundwater to wells or storing a significant amount of water. A groundwater basin is three-dimensional and includes both the surface extent and all of the subsurface fresh water yielding material

groundwater divide – the boundary between two adjacent groundwater basins, which is represented by a high point in the water table

groundwater recharge reuse – use of recycled water for groundwater recharge projects.

Hetch-Hetchy system – the water system constructed and owned by the San Francisco Public Utilities Commission that serves water from Hetch-Hetchy reservoir in the Sierra Nevada mountains to Milpitas, San Jose, Santa Clara, Sunnyvale, Mountain View, Palo Alto, and Stanford University, in addition to San Francisco and numerous other municipalities

inelastic land subsidence – permanent subsidence that results when sediments are compressed beyond their previous maximum effective stress, which generally occurs when groundwater levels decline past historic low levels

land subsidence – the gradual settling of the land surface owing to compaction of aquifer materials

managed aquifer recharge – the practice of artificially increasing the amount of water that enters a groundwater reservoir by diverting water to percolation ponds and timing reservoir releases to optimize in-stream recharge

mountain front recharge – subsurface inflows from bedrock in the hills surrounding the Santa Clara Plain, and inflow from uncontrolled reaches of streams

permeability – a measure of how well porous soil or bedrock can transmit water or other fluids

personal care products – consumer products including fragrances, topical agents such as cosmetics and sunscreens, laundry and cleaning products; and all the “inert” ingredients that are part of these products

saline intrusion – movement of saline water into aquifers, most often due to the incursion of saline water in the lower reaches of creeks in the Santa Clara Plain

San Felipe Project – the San Felipe Division of the federal Bureau of Reclamation’s Central Valley Project, includes the Santa Clara Valley. The project delivers 132,400 acre-feet of water annually for municipal and industrial use to users in Santa Clara and San Benito counties

sewer line exfiltration – movement of wastewater outside sewer pipes into soil and groundwater due to defects in sewer pipe materials, construction, or due to damage

storage capacity – the amount of groundwater of suitable quality that can be economically withdrawn from storage within economic, institutional, physical, and/or chemical constraints

total dissolved solids – represents the total concentration of dissolved substances in water. TDS is made up of inorganic salts, as well as a small amount of organic matter. Common inorganic salts that can be found in water include calcium, magnesium, potassium and sodium,

which are all cations, and carbonates, nitrates, bicarbonates, chlorides and sulfates, which are all anions. Cations are positively charged ions and anions are negatively charged ions

unconfined aquifer – an aquifer that is open to receive water from the surface, and whose water table surface is free to fluctuate up and down, depending on the recharge/discharge rate. There are no overlying "confining beds" of low permeability to physically isolate the groundwater system

water banking – the practice of forgoing water deliveries during certain periods, and "banking" either the right to use the forgone water in the future, or saving it for someone else to use in exchange for a fee or delivery in kind

APPENDIX 1 – Recycled Water Policy

State Water Resources Control Board

Recycled Water Policy and Amendments

APPENDIX 2 – Groundwater Management Plan

Groundwater Management Plan

Basin Management Objectives and Strategies

Figure 43 – District Board Policy Framework

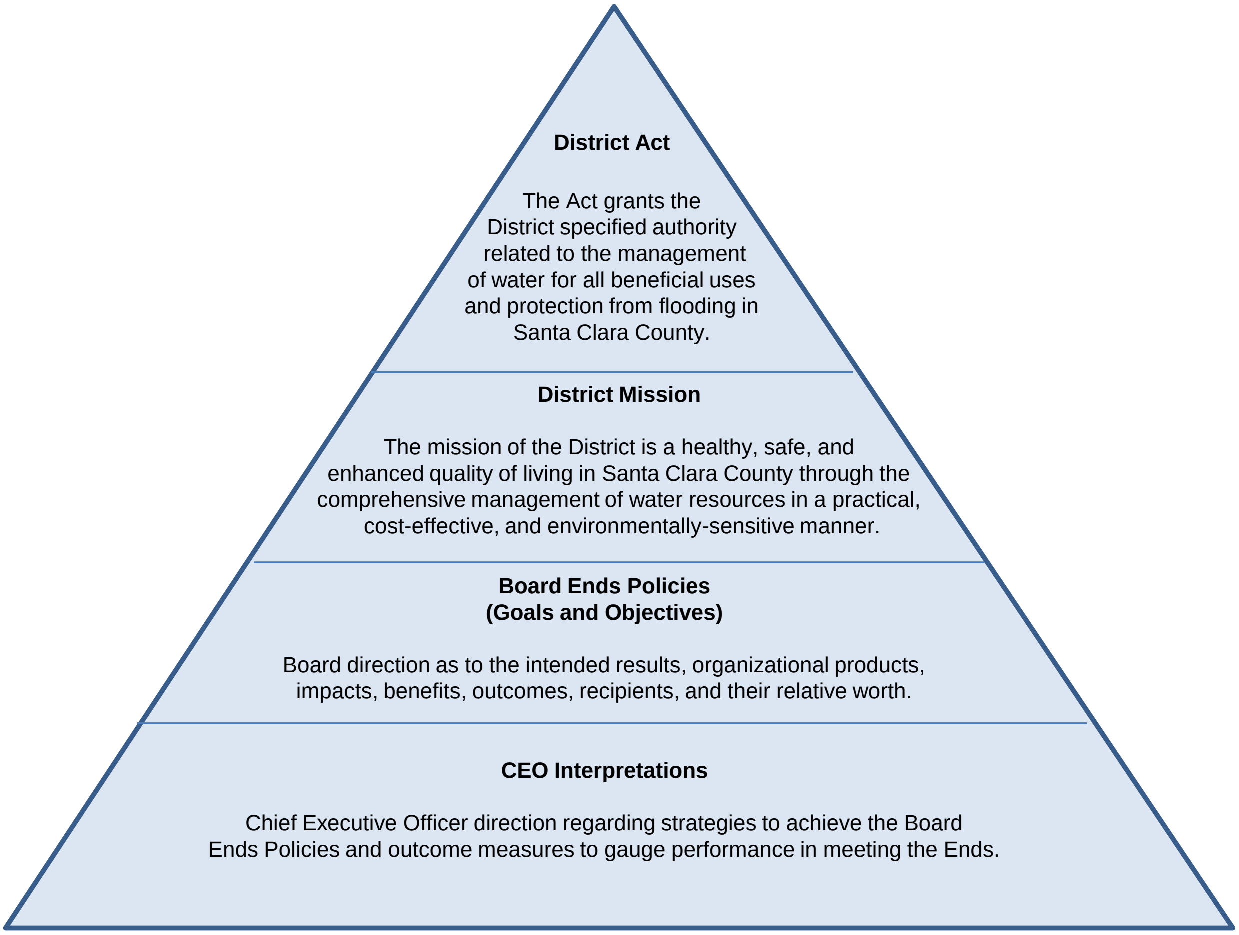
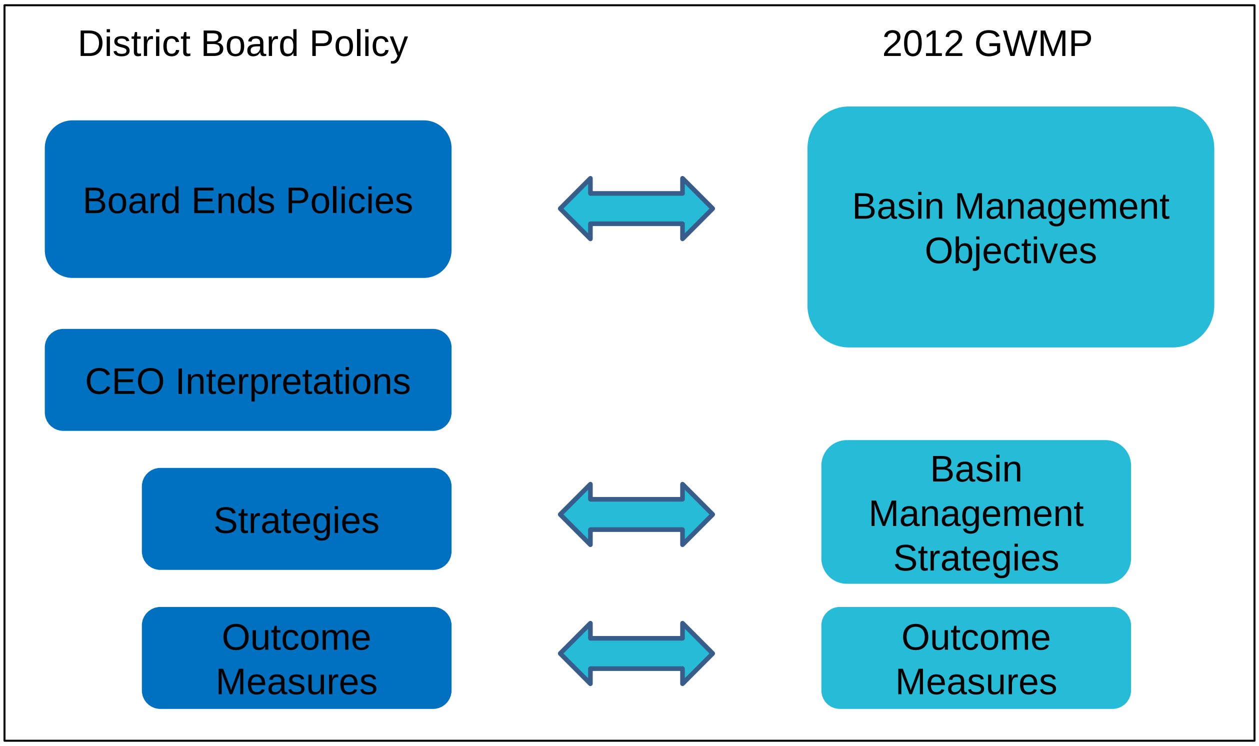


Figure 44 – Relation Between District Policy and 2012 GWMP



A-1.2 BASIN MANAGEMENT OBJECTIVES

Using the District's overall water supply management objectives, the following basin management objectives (BMOs) were developed:

BMO 1: Groundwater supplies are managed to optimize water supply reliability and minimize land subsidence.

BMO 2: Groundwater is protected from existing and potential contamination, including saltwater intrusion.

These BMOs describe the overall goals of the District's groundwater management program. The rationale and meaning of these objectives, as well as their relationship to District policies, are discussed below.

Water Supply Reliability and Minimization of Land Subsidence (BMO 1)

BMO 1: Groundwater supplies are managed to optimize water supply reliability and minimize land subsidence.

The District relies on groundwater for a significant portion of the county's water supply, particularly in South County where groundwater provides more than 95% of supply for all beneficial uses and 100% of the drinking water supply. Local groundwater resources make up the foundation of the county's water supply, but they need to be augmented by the District's comprehensive water supply management activities in order to reliably meet the needs of county residents, businesses, agriculture and the environment. The District relies on the

conjunctive use of groundwater and surface water to meet the county's water demands now and in the future.

The District's goal of minimizing land subsidence is combined with the water supply reliability goal since the actions taken to address one also addresses the other. Significant historical land subsidence due to groundwater overdraft was essentially halted by about 1970 through the District's expanded conjunctive use programs, which allowed groundwater levels to recover substantially. The avoidance of inelastic (or permanent) land subsidence has been a major driver for the District over its history given the extremely high costs associated with reduced carrying capacity of flood control structures, damage to infrastructure, and saltwater intrusion.

BMO 1 reflects the District's integrated approach to water supply reliability and commitment to minimizing land subsidence and is consistent with the following Board policies:

Board Water Supply Goal 2.1: Current and future water supply for municipalities, industries, agriculture, and the environment is reliable.

Board Water Supply Objective 2.1.1: Aggressively protect groundwater from the threat of contamination and maintain and develop groundwater to optimize reliability and to minimize land subsidence and saltwater intrusion.

Groundwater Quality Protection (BMO 2)

BMO 2: Groundwater is protected from existing and potential contamination, including saltwater intrusion.

While surface water goes through significant treatment processes before being served as drinking water, groundwater in this county typically does not require wellhead treatment before being served. Although the District does not serve groundwater directly to consumers, as the local groundwater management agency the District works to help ensure that the groundwater used by the residents and businesses of Santa Clara County is of reliably high quality.

In highly urbanized areas such as the Bay Area, there are numerous threats to groundwater quality including urban runoff, industrial chemicals, and underground storage tanks. Residential and agricultural use of pesticides and nitrogen-based fertilizers can also impact groundwater quality. Although the process of moving through soil layers provides some filtration of water, this natural process is not effective for all contaminants.

Groundwater degradation may lead to costly treatment or even make groundwater unusable, resulting in the need for additional supplies. Preventing groundwater contamination is more cost effective than cleaning up polluted groundwater, a process that can take many decades or longer depending on the nature and extent of the contamination. Notable contamination sites in the county requiring significant groundwater cleanup include large solvent releases at the IBM and Fairchild sites in south San Jose in the 1980s, and the Olin perchlorate release in Morgan Hill, which was discovered in the early 2000s.

Historically, saltwater intrusion has been observed in the shallow aquifer adjacent to San Francisco Bay during periods of higher groundwater pumping and land subsidence. Significant increases in groundwater pumping or sea level rise due to climate change could potentially lead to renewed saltwater intrusion.

The goal of the District's groundwater quality protection programs is to ensure that groundwater is a viable water supply for current and future beneficial uses. In addition to the primary deep drinking water aquifers, the District works to protect the quality of all aquifers in the subbasins, including shallow groundwater, as these are potential future sources for drinking water or other beneficial use.

Section 5 of the District Act authorizes the District to prevent the pollution and contamination of District surface water and groundwater supplies. BMO 2 is consistent with the District Act and with Board Water Supply Objective 2.1.1.

A-2.3 Basin Management Strategies

The basin management strategies are the methods that will be used to meet the BMOs. Many of these strategies have overlapping benefits to groundwater resources, acting to improve water supply reliability, minimize subsidence, and protect groundwater quality. The strategies are listed below and are also described in detail in this section.

1. Manage groundwater in conjunction with surface water through direct and in-lieu recharge programs to sustain groundwater supplies and to minimize saltwater intrusion and land subsidence.

2. Implement programs to protect or promote groundwater quality to support beneficial uses.

3. Maintain and develop adequate groundwater models and monitoring systems.

4. Work with regulatory and land use agencies to protect recharge areas, promote natural recharge, and prevent groundwater contamination.

Strategy 1: Manage groundwater in conjunction with surface water through direct and in-lieu recharge programs to sustain groundwater supplies and to minimize saltwater intrusion and land subsidence.

The District relies on groundwater subbasins to help meet water demands, naturally transmit water over a wide area, and provide critical storage reserves for emergencies such as droughts or other outages. Because groundwater pumping far exceeds what is replenished naturally, the District manages groundwater and surface water in conjunction to ensure the groundwater subbasins remain an important component in meeting current and future water demands.

Maintaining the District's comprehensive managed recharge program using both local and imported waters is critical to sustaining groundwater supplies. This requires maintaining water supply sources and existing recharge facilities as well as developing additional recharge facilities to help support future needs as identified in the District's Water Supply and Infrastructure Master Plan. Currently, several of the District reservoirs have restricted storage capacity due to limitations imposed by Division of Safety of Dam (DSOD). Resolving dam safety issues that currently restrict reservoir storage is also an important component of this strategy.

Just as important as direct recharge are the availability of SFPUC supplies to the county, the District's treated water deliveries, water conservation and water recycling programs, which serve as in-lieu recharge by reducing groundwater demands. Together these programs help to

maintain adequate groundwater storage, keep groundwater levels above subsidence thresholds, and maintain flow gradients toward San Francisco Bay. This, in turn, supports groundwater pumping and minimizes risks related to land subsidence and saltwater intrusion.

The District's managed recharge and in-lieu programs are described in detail in Chapter 4 and specific outcome measures related to groundwater levels and storage are discussed in Chapter 6.

Strategy 2: Implement programs to protect or promote groundwater quality to support beneficial uses.

Groundwater in Santa Clara County is generally of very high quality, with few public water systems requiring wellhead treatment prior to delivery to customers. The District evaluates groundwater quality and potential threats so that changes in groundwater quality can be detected and appropriate action can be taken to protect the quality of groundwater resources. This includes assessing regional conditions and trends, evaluating threats to groundwater quality including emerging contaminants, conducting technical studies such as vulnerability assessments, and implementing strategies to protect groundwater from contaminant sources.

Groundwater protection programs are described in detail in Chapter 4 and specific outcome measures related to groundwater quality are presented in Chapter 6.

Strategy 3: Maintain and develop adequate groundwater models and monitoring systems.

Comprehensive monitoring programs provide critical data to understand groundwater conditions and support operational decisions, including the timing and location of managed recharge. The District has implemented programs to regularly monitor groundwater levels, groundwater quality (including monitoring near recycled water irrigation sites), recharge water quality, surface water flow, and land subsidence. Local water retailers also collect groundwater quality data for compliance with California Department of Public Health regulations and monitor groundwater levels. Data from these programs is essential to evaluating current conditions, preventing groundwater overdraft and subsidence, and measuring the effectiveness of basin management programs and activities. These monitoring programs and related monitoring protocols are described in Chapter 5.

The District has also developed models to support operational decisions and long-term planning. These include operational and water supply system models, as well as models specific to groundwater. The District has developed calibrated flow models for the Santa Clara Plain, Coyote Valley, and the Llagas Groundwater Subbasin, which are used to evaluate groundwater storage and levels under various operational and hydrologic conditions. These models are used to support ongoing water supply operational decisions as well as long-term planning efforts. Maintaining calibrated models that can reasonably forecast groundwater conditions is critical to the District's comprehensive groundwater management strategy.

Strategy 4: Work with regulatory and land use agencies to protect recharge areas, promote natural recharge, and prevent groundwater contamination.

Since the 1950s, land use in the Santa Clara Plain has changed from largely rural and agricultural to a highly developed urban area. The increased amount of land covered by impervious materials has increased runoff and reduced natural recharge. Although not as urbanized as the Santa Clara Plain, the Llagas Groundwater Subbasin serves the growing cities

of Morgan Hill and Gilroy, and significant development has been considered in the Coyote Valley. This strategy calls for working with land use agencies to maximize natural recharge by protecting groundwater recharge areas and supporting the use of low-impact development.

Increased urbanization also increases the risk of contamination particularly in groundwater recharge areas, which are more vulnerable due to the presence of highly permeable sediments. The District coordinates with land use agencies with regard to potentially contaminating land use activities and resource protection. Regulatory agencies also play a critical role in groundwater protection with regard to the establishment of water quality objectives and the cleanup of contaminated sites. The District will continue to work with these agencies and identify opportunities for enhanced cooperation to minimize impacts from existing contamination and prevent additional contamination from occurring. This includes the development of technical studies, participation in policy development, and coordination on proposed development.

The relationship between the basin management objectives, strategies, and related programs and activities, is shown below in Figure 17.

Figure 45 – Relation Between Basin Management Objectives, Strategies, and Programs

Basin Management Objectives

BMO 1: Groundwater supplies are managed to optimize water supply reliability and minimize land subsidence.

BMO 2: Groundwater is protected from existing and potential contamination, including salt water intrusion.

Basin Management Strategies

1. Manage groundwater in conjunction with surface water through direct and in-lieu recharge programs to sustain groundwater supplies and to minimize salt water intrusion and land subsidence.
2. Implement programs to protect or promote groundwater quality to support beneficial uses.
3. Maintain and develop adequate groundwater models and monitoring systems.
4. Work with regulatory and land use agencies to protect recharge areas, promote natural recharge, and prevent groundwater contamination.

Programs and Activities (Chapter 4)

Programs to maintain water supply reliability and minimize land subsidence

Programs to protect groundwater quality

APPENDIX 3 – Groundwater Monitoring Plan

SNMP Groundwater Monitoring Plan for the Santa Clara Groundwater Subbasin

APPENDIX 4 – Groundwater Quality Management

Local Government Groundwater Quality Management Program

Groundwater Quality Management Programs

Salt and nitrate loading projections show that the average basin concentrations of TDS and nitrate in the Santa Clara Plain and Coyote Valley comply with the RWQCB's Basin Plan Objectives throughout the 25-year evaluation period. Nitrate concentrations are projected to decrease in both the Santa Clara Plain and Coyote Valley. Salt concentrations (as TDS) are projected to decrease in Coyote Valley, but will increase in the Santa Clara Plain at a rate of approximately 1.1 mg/L/year, while Basin Plan Objectives are not projected to be exceeded through 2035. Accordingly, Implementation Measures are not required for the Santa Clara Groundwater Subbasin SNMP.

Good groundwater management practice includes programs that can proactively protect groundwater quality from salt loading in the long term and there are a variety of programs and policies that cause a net reduction in salt loading. This section describes programs that have the added benefit of groundwater quality protection by limiting or reducing salt loading. Developing a quantitative enumeration of the reduction in salt loading attributable to each activity is a major undertaking that is made difficult by the inherent uncertainties of future projections. Accordingly, a qualitative description of these activities is provided. The benefit of the water quality protection programs described below is incorporated into the projections for future assimilative capacity.

A-4.1 Existing Programs and Activities that Mitigate Salt and Nutrient Loading

Existing programs can be categorized by the medium from which they reduce salt loading, which correlates to Figure 15 (Relationship of Salt and Nutrient Sources to Groundwater). For example, surface water management activities include stormwater management and conjunctive use. Wastewater management includes pretreatment programs and improvements to recycled water quality. Groundwater quality programs can include groundwater quality monitoring and reducing direct loading to groundwater from lawn and garden fertilizers. Water quality protection activities are described in more detail in the following sections.

A-4.1.1 Surface Water Programs

Programs, policies, and activities that improve the quality of surface water that infiltrates to groundwater are listed below:

- Construction stormwater management.
- Mitigation of drainage impacts from new developments (low impact development).
- Enforcement of National Pollution Discharge Elimination System (NPDES) requirements (e.g., eliminating non-stormwater discharges to storm drains).
- Rainwater capture, storage, and infiltration.

The majority of the programs that reduce salt and nitrate loading are required by or addressed in the Municipal Regional Stormwater NPDES Permit (MRP) issued in October 2009. The cities of Campbell, Cupertino, Los Altos, Milpitas, Monte Sereno, Mountain View, Palo Alto, San Jose, Santa Clara, Saratoga, and Sunnyvale, the towns of Los Altos Hills and Los Gatos, the Santa Clara Valley Water District, and Santa Clara County, have joined together to form the Santa

Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP). SCVURPPP's goals include prohibiting non-stormwater discharges and reducing pollutants in stormwater runoff, as well as administering compliance with the Municipal Regional Permit. The SCVURPPP program has been operating since 1990 and continues to promote awareness of and compliance with the MRP requirements. The centerpiece of the SCVURPPP program is the Watershed Watch Campaign, a multi-year education and outreach effort designed to increase the public's awareness of urban runoff issues including pollution prevention. SCVURPP also provides on-line resources such as guidance on low impact development (LID), rainwater harvesting, and contractor compliance with stormwater management requirements. All of the cities in the Santa Clara Plain participate in and promote the SCVURPPP programs. Because stormwater recharges groundwater, improvements to stormwater quality can decrease salt and nitrate loading to groundwater.

The cities and towns in the Santa Clara Plain have codified requirements for stormwater pollution prevention. Many of these municipal codes require permanent stormwater pollution prevention measures for development and redevelopment projects that will reduce water quality impacts of stormwater runoff from the site for the life of the project. For example, the City of Mountain View has published Storm Water Quality Guidelines for Development Projects. Similar requirements are included in the municipal codes and city policies as listed in Table 44, below. The cities of Campbell, Monte Sereno, Saratoga, and Los Gatos formed the West Valley Clean Water Program to reduce pollutants in storm drain discharges and maximize the effectiveness of pollution prevention efforts by the four West Valley Communities.

Table 44 – Example City Requirements for Stormwater Pollution Prevention

City	Requirement	Reference
San Jose	Minimize and treat stormwater runoff from new/re-development projects per MRP: use LID	Council Policy 6-29
Milpitas	Stormwater and Urban Runoff Pollution Control	Muni Code Ch 16
Santa Clara	Control of unauthorized discharges	City Code Ch 13.20
Sunnyvale	Stormwater and Urban Runoff Pollution Control: LID reqs.	Muni Code Ch12.60
Mountain View	Stormwater Treatment at New/Redevelopment Projects	Muni Code Ch 35.34
Palo Alto	Treat storm water runoff using LID techniques	Muni Code Ch 16.11
Los Altos	Treatment of stormwater runoff with LID measures, including rainwater harvesting and reuse, infiltration, evapo-transpiration or biotreatment	Muni Code Ch 10.16
Cupertino Saratoga Campbell Los Gatos	Discharge to storm drains prohibited Storm Water Prevention Plan (SWPPP) http://www.cleancreeks.org/	Cupertino Muni Code 9.18.040, 9.18.090; Los Gatos Muni Code Ch. 12;

Individual City Stormwater Requirements may include extensive measures to protect stormwater quality. For example, the City of Mountain View requires the following:

- Development projects shall submit a stormwater management plan in accordance with the city's guidelines.

- Property owners must ensure that permanent stormwater pollution prevention measures are inspected twice annually to ensure they are working properly, and written inspection must be submitted to the city annually (an enforceable requirement).
- The city has the right of entry to inspect and repair stormwater pollution prevention measures.

New development and redevelopment projects that create or replace more than 10,000 square feet of impervious surface are required to implement Low Impact Development site design, source control, and treatment measures to address stormwater runoff pollutants and prevent increases in runoff flows. In addition, projects that add or replace one acre or more of impervious surface are required to include hydromodification control measures. These requirements limit post-project runoff to the estimated pre-project runoff rates and durations. Stormwater treatment and site design measures, such as grassy swales, bioretention, and detention in landscaping all help to detain and infiltrate increased flows.

To gauge the effectiveness of stormwater pollution prevention measures, SCVURPPP conducts a range of surface water quality monitoring activities at varying spatial scales. These include studies designed to assess water quality and beneficial uses in local creeks and the San Francisco Bay, and loading studies to evaluate the proportion of pollutants entering the Bay from local tributaries. Studies on local water bodies are typically conducted through the Program's Multi-Year Monitoring Program. Monitoring activities are conducted to evaluate pollutant loading to San Francisco Bay. These studies are conducted through regional partnerships (e.g., the Regional Monitoring Program for Water Quality).[26]

The Multi-Year Monitoring Program has collected and analyzed screening level water quality monitoring data from 73 creek sites located within the Santa Clara Plain in the last ten years. Water samples were analyzed for conventional water quality parameters, chemical pollutants (metals and organic contaminants), aquatic toxicity, and pathogen indicators (SCVURPPP, 2006).

A-4.1.2 Stormwater Infiltration Devices

Low-impact development initiatives often promote design with stormwater infiltration devices to reduce runoff and increase groundwater recharge. Stormwater infiltration devices such as dry wells and infiltration basins help to reduce runoff to creeks that carries pollutants to the bay. However, these devices also have the potential to introduce pollutants to groundwater. Dry wells may be constructed to penetrate saturated aquifers, eliminating the benefit of soil filtration that removes some dissolved constituents. Infiltration basins that are excavated to a depth that penetrates the saturated zone may also introduce salts and nutrients to groundwater. Other stormwater infiltration devices, such as bio-swales, are designed to enhance filtration of stormwater before it percolates to groundwater. While bio-swales may facilitate precipitation or adsorption of metals, oil and grease, these structures can be expected to transmit dissolved salts and nitrate (with some nitrate attenuation).

The Federal Clean Water Act requires local municipalities to implement measures to control pollution from their storm sewer systems to the maximum extent practicable. Under the auspices of the Clean Water Act, the San Francisco RWQCB issued an area-wide National Pollutant Discharge Elimination System Permit (NPDES MS4) to the fifteen co-permittees of the Santa Clara Valley Urban Runoff Pollution Prevention Program (SCVURPPP) for the discharge

[26] http://www.sfei.org/node/1074

of storm water from urban areas in Santa Clara County. The fifteen SCVURPPP co-permittees are the thirteen municipalities within the Santa Clara Basin watershed area[27], the County of Santa Clara, and the Santa Clara Valley Water District.

The SCVURPPP Permit requires each of the co-permittees to ensure the reduction of pollutant discharges from development projects through incorporation of treatment and other appropriate source control and site design measures. The SCVURPPP NPDES Permit establishes minimum design criteria and maintenance requirements in certain types of development projects.

In order to protect groundwater from pollutants that may be present in urban runoff, treatment control measures such as infiltration trenches and infiltration basins must meet the following conditions:

a. Pollution prevention and source control BMPs shall be implemented to the extent necessary to protect groundwater quality at sites where infiltration devices are to be used.

b. Infiltration devices may not contribute to degradation of groundwater quality.

c. Infiltration devices must be adequately maintained to maximize pollutant removal capabilities.

d. The vertical distance from the base of any infiltration device to the seasonal high groundwater must be at least 10 feet.

e. Unless storm water is first treated by a means other than infiltration, infiltration devices may not be used in areas of:

    - industrial or light industrial activity;
    - areas subject to high vehicular traffic (25,000 or greater average daily traffic on main roadway or 15,000 or more average daily traffic on any intersecting roadway);
    - automotive repair shops, car washes, fleet storage areas (bus, truck, etc.);
    - nurseries;
    - any other land use or activity which may pose a high threat to groundwater quality, as designated by the City.

f. Infiltration devices must be located a minimum of 100 feet horizontally from any known water supply wells.

The SCVURPPP Permit is available online at:

http://www.waterboards.ca.gov/rwqcb2/water_issues/programs/stormwater/Municipal/R2-2009-0074_Revised.pdf

In 2012, the District partnered with SCVURPPP to develop updated stormwater infiltration device standards for the Regional NPDES stormwater permit. The standards are included in Appendix A of the C.3 Stormwater Handbook.[28]

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[27] Campbell, Cupertino, Los Altos, Milpitas, Monte Sereno, Mountain View, Palo Alto, San Jose, Santa Clara, Saratoga, and Sunnyvale, and the towns of Los Altos Hills and Los Gatos.

A-4.1.3 Water Conservation Programs

A major source of salt loading identified in Section 3.2.1.7 is landscape irrigation. Due to evaporation, the TDS concentration in irrigated water is effectively concentrated as much as ten-fold and nearly all of the salt in irrigated water ultimately migrates to groundwater. Therefore, conservation of outdoor irrigation water has a direct effect on reducing salt loading.

The District Board of Directors established Water Supply Objective (E-2.1.5) to “maximize water use efficiency, water conservation and demand management opportunities.” The District CEO has also established a specific Outcome Measure (OM 2.1.5.a) for this objective, which aims to conserve at least 98,000 AF/yr by the year 2030.

Indoor and outdoor water conservation is already a core stratagem for managing water supply reliability however, most water conservation savings have been realized from indoor water conservation measures. As discussed in 3.3.5.4, one consequence of indoor conservation is higher TDS and nitrate in wastewater. When indoor water conservation measures are employed (e.g., shorter showers, low-flush toilets), salt and nitrate added to wastewater through household activities is dissolved into a smaller volume of water, with a corresponding increase in salt and nitrate concentration. As a result, the TDS and nitrate concentrations of tertiary-treated recycled water are increased.

Outdoor water conservation includes replacing water intensive lawns and gardens with drought-resistant native plants that require substantially less water, improving efficiency of lawn sprinklers, promoting weather-based irrigation controllers, and other measures. For example, the Bay Area Water Supply and Conservation Agency (BAWSCA), comprised of cities whose water is supplied in part by the San Francisco Public Utility Commission, hosts workshops on sustainable landscaping, water-use efficiency in the landscape, use of California native and drought tolerant plants, alternatives to lawns, water efficient irrigation practices, and more.[29] An added benefit to replacing lawns with native or drought-tolerant plants is to reduce or eliminate the need for supplemental fertilizers, which cause salt and nitrate loading to groundwater.

The Santa Clara Valley Water District and San Jose Water Company offer residents free “water-wise house calls” in which an inspector advises homeowners of opportunities to save water, including evaluating the efficiency of sprinkler systems, issuing an individualized irrigation schedule, identifying irrigation leaks, broken or mismatched sprinkler heads, and other common irrigation problems. For example, in 2012, San Jose Water Company completed 1,936 water use audits, including:

- 1,045 Single Family residential;
- 400 landscape only;
- 59 indoor only;
- 242 multi-family residential;
- 35 commercial;
- 155 dedicated irrigation sites.

[28] http://www.scvurppp-w2k.com/permit_c3_docs/c3_handbook_2012/Appendix_A-Infiltration_Guidelines_2012.pdf
[29] The Cities participating in BAWSCA include Milpitas, Mountain View, Palo Alto, San Jose, Santa Clara, Sunnyvale, Purissima Hills Water District, and Stanford University. The sustainable landscaping *Green Gardner Program* is described here: http://www.mywatershedwatch.org/greengardener.html.

The San Jose Water Company and Santa Clara Valley Water District have also created demonstration gardens at their campuses to educate homeowners on landscape design with drought tolerant native plants.

The District also operates a Landscape Rebate Program, in which residents and businesses can receive rebates for upgrading irrigation hardware, installing weather-based irrigation controllers, and replacing high-water using landscape with qualifying low-water using plants.

The District is currently planning a Landscape Water Use Evaluation Program, which will provide real-time water use reports comparing actual water usage against a recommended water budget to large landscape sites. On-site surveys will be performed as needed. The estimated savings from outdoor water conservation programs operated by the District in 2012 is 1,200 AF/yr. The projected savings from District managed outdoor water conservation for 2030 is 10,300 AF, which would avert future TDS loading of about 4,000 tons salt per year.

Gray water (non-toilet wastewater, i.e., from washing machines, dishwashers, showers and baths, kitchen sink water, etc.) is another potential source of irrigation water. The District is promoting gray water use through a rebate program that funds installation of systems that take washing machine effluent directly into drip irrigation systems. The program is limited in scope and is expected to decrease the demand for outdoor irrigation water by 300 AF, depending on the extent of homeowner participation. While gray water displaces retailer water now used for outdoor irrigation, it has higher TDS than the water it is displacing. Household wastewater typically has TDS that is ~200 mg/L higher than the source water (Kaplan, 1991). Of the sources of TDS in wastewater, 42% comes from washing machines using conventional detergents (Siegrist et al., 1976). On this basis, 300 AF/yr of graywater use would add ~34 tons of salt/year. However, best management practices for graywater systems include promoting low-salt detergents. Therefore, at the subbasin scale, TDS loading from graywater use is expected to be negligible for the volumes considered in the District's graywater system rebate program.

A-4.1.4 Groundwater Management Programs

Several groundwater management programs and policies decrease salt and nitrate loading or increase recharge with water that is low in salts and nitrates. A wide range of existing programs that focus on other objectives is aligned with loading reduction and increased recharge of high quality water.

A-4.1.4.1 Composting

Composting greenwaste generated from gardening activities and then adding compost to soil lowers the plant demand for fertilizers. While compost is not itself a fertilizer, soils amended with compost have improved capacity for storing nutrients for gradual release. Compost added to soil also improves soil water retention capacity, thereby reducing demand for irrigation water. Mulch also serves to conserve irrigation water for landscaping.

Increasing the use of compost and mulch in gardens is the goal of several outreach programs, which have the joint objective of reducing solid waste generation. Table 45 lists some of the ongoing compost and mulch outreach programs.

Table 45 – Compost and Mulch Programs in the Santa Clara Groundwater Subbasin

<table>
<tr><th>Jurisdiction</th><th>Program</th><th>Link</th></tr>
<tr><td>SCVURPPP + Solid Waste Programs</td><td>Eco-Gardeners Program</td><td>http://www.bayareaecogardens.org/</td></tr>
<tr><td>City of Palo Alto</td><td>Garden Workshops – Composting</td><td>http://www.cityofpaloalto.org</td></tr>
<tr><td>City of Mountain View</td><td>Composting & Yard Trimmings Program</td><td>http://www.ci.mtnview.ca.us</td></tr>
<tr><td>City of Sunnyvale</td><td>Monthly Home Composting Workshops</td><td>www.recycling.insunnyvale.com</td></tr>
<tr><td>City of Santa Clara</td><td>Partners with County of Santa Clara Master Composter Program</td><td>http://www.sccgov.org/sites/iwm/hc/Pages/How-to-Compost.aspx</td></tr>
<tr><td>City of San Jose</td><td>Composting classes and bin sales</td><td>http://www.sanjoseca.gov/calendar.aspx</td></tr>
<tr><td>City of Milpitas</td><td>Partners with County of Santa Clara Recycling and Waste Reduction Commission Programs</td><td rowspan="5">http://www.sccgov.org/sites/iwm/hc/pages/classes.aspx</td></tr>
<tr><td>City of Campbell</td><td>Partners with County of Santa Clara</td></tr>
<tr><td>City of Cupertino</td><td>Free compost; Partners with County of Santa Clara</td></tr>
<tr><td>City of Saratoga</td><td>Compost bin sales and partners with County of Santa Clara</td></tr>
<tr><td>City of Morgan Hill</td><td>Partners with County of Santa Clara</td></tr>
</table>

A-4.1.4.2 Fertilizer Management

Agricultural fertilizer use in the Santa Clara Plain is a minor component of overall estimated nitrate loading (78 tons per year or 8.7%), but is the primary component of nitrate loading estimates for Coyote Valley (117 tons per year or 54.8% – see Table 29). Estimated nitrate loading from lawn fertilizer (76 tons per year) makes up 8.4% of nitrate loading in the Santa Clara Plain and 1.4% (3 tons) of nitrate loading in Coyote Valley. Several programs educate homeowners on optimal fertilization rates, timing, and application methods. For example, the Santa Clara County Integrated Pest Management program provides outreach materials for healthy lawn care practices that achieve both fertilizer and irrigation reduction (www.sccgov.org). The Santa Clara County Master Gardeners program conducts similar outreach for “water-wise lawns” (http://www.mastergardeners.org/scc.html).

The University of California Cooperative Extension –“Healthy Crops, Safe Water Initiative” promotes reduced agricultural fertilizer use. Some achievements include:

- Developed best management practices to minimize nitrate leaching in irrigated crop production.

- Developed “nitrate quick test” for managing fertilizer decisions in vegetable production.

- Studying the nitrogen use efficiency of high-nitrogen crops to improve timing of fertilizer application.
- Promoting fall-planted non-legume cover crops that can take up in excess of 100 lb N/acre (nitrogen that otherwise could leach to groundwater).

In the past, the District operated the Infield Nutrient Assessment Assistance Program (INAAP). The INAAP program provides:

- Free testing of agricultural pumps and irrigation systems.
- Irrigation scheduling consultation.
- Testing and consultation in plant nutrient status and fertilizer management for three years.

The program's objectives were to increase water and nutrient use efficiencies and reduce nitrogen fertilizer loading to groundwater. The program ended in 2008 due to insufficient funding and participation.

A-4.1.4.3 Septic Tank Management

Effluent from septic tank leach fields adds nitrate and salt to groundwater. About 10% (38 tons) of the estimated nitrate loading in Coyote Valley is from septic tanks, while there are fewer than 100 septic tanks in the Santa Clara Plain. The County of Santa Clara issues septic tank permits. In December, 2013, the County adopted a new Onsite Wastewater Treatment System Ordinance (OWTSO), which became effective on December 26, 2013. The OWTSO modernizes construction standards and citing requirements for the disposal of wastewater on site, and allows for alternative treatment technologies.

The OWTSO requires applicants to conduct a backhoe excavation to verify the soil profile to a depth of 5 feet below ground surface, and a wet weather groundwater investigation where the water table is high. The County's septic tank ordinance requires groundwater to be at least 5 feet below the leachfield in soils with moderate percolation rates, and 20 feet in highly permeable soils. For alternative OWTS a 2 to 5-foot separation to groundwater is required.

The County has published an extensive Onsite Systems Manual,[30] which provides updated information regarding design details and guidelines for conventional and alternative systems, and system operating and monitoring requirements.

To the extent that new systems may replace older, conventional systems, some reduction in nitrate loading may be realized. For example, recirculating sand filters (e.g., Venhuizen Standard Denitrifying Sand Filter) can provide additional nitrogen removal, as can aerobic treatment units and alternative media filters. However, the OWTSO does not require that older or failing systems be replaced rather, OWTSO requires that they be repaired. Some homeowners may be motivated to install alternative treatment technologies to address challenging soil conditions, extend the life of the leach field, or to achieve other advantages. Nevertheless, it is difficult to predict the effect that the new OWTSO will have on nitrate loading.

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30 http://www.sccgov.org/sites/deh/Consumer%20Protection%20Division/Program%20and%20Services/Land%20Use%20Program/Pages/Onsite-Wastewaster-Treatment-Systems-Ordinance.aspx

A-4.1.4.4 Livestock Manure Management

In addition to onsite wastewater management, many rural residences in Coyote Valley and some parts of the Santa Clara Plain must also deal with livestock wastes. The County has recommended best management practices for mud and manure management to owners of horses, goats, sheep and other livestock (http://livestockandland.org/resources/). The website includes guidance on manure composting, manure management, designing horse paddocks to protect water quality, stormwater management, and more, in both English and Spanish. At Stanford University, the equestrian program includes manure composting and stormwater management.

A-4.1.4.5 Groundwater Monitoring Programs

As described in Appendix 3, the District operates a county wide groundwater monitoring program that includes analysis for nitrate and TDS. Annual reports include summary statistics by subbasin and trend analyses in individual wells. Monitoring does not in itself change loading, but it is a required element of salt and nutrient management in order to determine the condition of the groundwater basin on an ongoing basis.

In addition to gaining a basin-wide understanding of groundwater conditions, it is important for individual domestic well owners to understand the quality of their well water. The District currently operates a free basic water quality-testing program for domestic well owners, which includes analysis of nitrate and has produced a detailed picture of the distribution of nitrate in domestic wells. Results from the domestic well testing program are included in the District's Annual Groundwater Report.

In order to understand the long-term impacts of recycled water on groundwater quality, the District has undertaken two programs to monitor groundwater beneath sites irrigated with recycled water (one in Edenvale/south San Jose and the other at two locations in Gilroy). Shallow monitoring wells are sampled at the Edenvale and Gilroy sites, and groundwater and recycled water are analyzed for TDS and nitrate, as well as a wide range of other constituents associated with recycled water, including constituents of emerging concern. Analyzing the concentration trends of TDS, nitrate, and other constituents over time provides insights to the impact of irrigation with tertiary treated recycled water on shallow groundwater at a local scale.

At the San Jose site, this monitoring program may also allow observation of the time lag between initiation of irrigation with lower TDS recycled water (tertiary treated recycled water blended with advanced treated recycled water, TDS of 500 mg/L), and any corresponding changes to groundwater TDS concentrations. Understanding the amount of time needed for groundwater quality to change in response to recycled water application can assist with refining salt loading projections.

The City of San Jose has also undertaken long term shallow groundwater monitoring at recycled water irrigation sites, using six shallow monitoring wells installed in 1997, and six deep production wells. Recycled water application at the shallow monitoring well sites began in 1999. Statistical analysis of long term concentration trends is updated periodically based on annual sampling in March each year.

A-4.1.4.6 Drinking Water Source Assessment Program and District Groundwater Vulnerability Assessment

The 1996 reauthorization of the federal Safe Drinking Water Act (SDWA) included an amendment requiring states to develop a program to assess sources of drinking water and encouraging states to establish drinking water source protection programs. The Drinking Water Source Assessment Program (DWSAP) includes delineation of the areas around drinking water sources through which contaminants might move and reach drinking water supplies. The DWSAP includes an inventory of “potentially contaminating activities” (PCAs) that might contribute to the release of contaminants within the delineated area. This enables a determination to be made as to whether the drinking water source might be vulnerable to contamination. The DWSAP was administered by the California Department of Public Health (CDPH) and implemented by each water retailer. DWSAP guidance identifies PCAs that have the potential to contribute salt or nitrate to groundwater, listed in Table 46.

Table 46 – Potentially Contaminating Activities Contributing Salt and Nitrate to Groundwater

Potentially Contaminating Activity	Nitrate Contribution	Salt Contribution
Agricultural Drainage	✓	✓
Car Washes		✓
Cement/concrete plants		✓
Food processing plants	✓	✓
Metal plating/finishing/ fabricating		✓
Dairies	✓	✓
Lagoons (for animal waste or irrigation tail water) and Agricultural Drainage	✓	✓
Golf Courses, Parks, Schools, Sports Fields, Cemeteries	✓	
Housing (lawn maintenance, swimming pools, etc.)	✓	✓
Landfills, Waste Transfer and Recycling, Composting	✓	✓
Mines/gravel pits		✓
Livestock operations	✓	✓
Irrigated crops	✓	✓
Apartments and condominiums	✓	✓
Sewer Lines and Septic Systems	✓	✓

Groundwater contamination from the above PCAs could result from the misuse and improper disposal of liquid and solid wastes; illegal dumping of household, commercial, or industrial wastes; accidental spills; and ongoing leaching from septic leach fields, construction sites, infiltration of roadway and parking lot runoff, and leaching of fertilizers from farms, landscaping, and lawns, parks, golf courses, cemeteries, and sports fields.

The DWSAP does not have an ongoing funding mechanism or mandate to update the inventories of PCAs. The intended benefit of the DWSAP program is to increase public awareness of the interconnection of land use activities and groundwater quality, and for planners to consider groundwater vulnerability in their permitting decisions.

In 2010, the District published a comprehensive Groundwater Vulnerability Study for Santa Clara County.[31] The study analyzed the two key components of groundwater vulnerability:

1) groundwater sensitivity, and 2) risk from potentially contaminating activities. Four factors were found to be the most important in characterizing groundwater sensitivity. These include 1) soil media characteristics in the unsaturated zone, 2) groundwater recharge, 3) depth to top of well screens, and 4) annual groundwater production. The potentially contaminating activities risk analysis found that large portions of the Santa Clara Plain are at high risk due to the high level of development and many associated industrial and commercial contaminant release sites, along with the lingering impacts of past agricultural releases. Although the confined zone in the Santa Clara Groundwater Subbasin affords relatively good protection from surface contamination, the outer western unconfined zone appears to be highly sensitive to contamination due to the significant groundwater production in this area.

Relatively lower overall risks from potentially contaminating activities are associated with the Coyote Valley, which is rural and less developed with far fewer industrial/commercial contaminant release sites. Nonetheless, most of Coyote Valley shows a moderate level of risk associated with irrigated agriculture. Although the risk from potentially contaminating activities is lower than in the Santa Clara Plain, the Coyote Valley exhibits high to very high vulnerability, which is driven by high sensitivity due to high recharge rates and permeable soils. Coyote Valley has the most potential for future development and thus the most potential for an increase in groundwater vulnerability in the future.

The Groundwater Vulnerability Study produced a detailed vulnerability map of the study area along with a Geographical Information System (GIS) tool, which allows the District to better focus groundwater management programs and assess potential groundwater quality impacts from future changes in land use. The tool features sensitivity (for Shallow and Principal Aquifers), PCA risk, and vulnerability maps (for Shallow and Principal Aquifers). Additional maps are also provided to enhance the usefulness of the tool. Pull-down menus feature tables with explanatory fields. The tool enables District staff to work interactively with the vulnerability study analysis. The objectives of the tool are to enable District staff to:

- Evaluate potential impacts of new developments.
- Prioritize basin management activities.
- Prioritize oversight of known contamination sites.

A-4.1.4.7 Water Distribution System Leak Detection Programs

Water utilities and water companies are motivated to locate and correct leaks in water distribution system piping to conserve costs and avoid nuisance conditions and possible secondary damage to streets and landscaping. Most water retailers are prepared to respond to major leaks or breaks 24/7 and are able to be on site within 30-minutes of dispatch. Water distribution piping is subjected to significant stresses that cause leaks to occur relatively frequently. Seven of the 13 water retailers serving the Santa Clara Plain and Coyote Valley

[31] http://www.valleywater.org/Services/GroundwaterStudies.aspx

reported the number of water main line and service connection breaks or leaks in the 2011 LAFCO report, “Santa Clara Countywide Water Service Review”. These seven retailers have 130,608 connections, and collectively experienced a total of 273 water main line leaks or breaks and 473 service connection leaks or breaks in 2010 (LAFCO, 2011).

Leak detection programs are pursued at the initiative of the water retailers to meet their system management and business needs. For example, the City of Sunnyvale conducted a pilot program to install “Smart Meters” allowing real-time monitoring using web-based analysis tools of water use at parks and City Facilties. The meters allow water use to be optimized, and the data collected to be analyzed to identify leaks. The program identified one leak of 224 gallons per hour (Aquacue, 2011). Other approaches commonly used for leak detection include temporary or permanent installation of acoustic data loggers that can detect leaks based on the sound produced by a leaking pipe.

To address leaks detected on privately owned service connections, many cities have Water Waste Ordinances. These ordinances prohibit water waste due to unattended open hoses, broken sprinkler heads or irrigation lines, plumbing leaks, and excessive irrigation running off property or spraying on sidewalks or gutters. Upon detecting a leak or violation, the party who owns the leaking pipe or irrigation system is given notice and a timeframe to correct the problem.

Water retailers also have capital improvement plans to periodically replace aging infrastructure. While leak detection programs help to locate and eliminate some system leaks, pipeline replacement with new materials installed using superior construction methods go much further to mitigating salt and nitrate loading from system losses.

The District operates 140 miles of pipelines for treated and untreated water. The District’s Leak Detection Program includes continuous 24 hour monitoring of meters on all major conveyance facilities, daily flow records, monthly pipeline inspections, and water balances. Meters are calibrated regularly as part of the District’s Preventative Maintenance Program. Average summertime raw water conveyance through District pipelines is approximately 200 million gallons per day. Flows in major facilities are monitored continuously with a SCADA system at the District's Operations Center and at each of the District's water treatment plants. Technicians and operators perform daily inspections and record metered and gaged flows daily to verify system integrity. Each month the right of way in which facilities are buried is inspected by helicopter for signs of leakage. An overall water balance and a treated water balance is conducted monthly to establish distribution and to identify possible meter problems or leakage. The District operates a facility for meter testing where smaller meters up to 24 inches are tested based upon volume or time period following AWWA standards, larger meters are periodically tested using volumetric methods where feasible, and all meters are calibrated to manufacturer's specifications regularly as part of the District's preventative maintenance program.

For the 2015 Urban Water Management Plan, the California Department of Water Resources is considering several amendments to plan reporting requirements. An Independent Technical Panel on Demand Management Measures released a public draft report to the legislature on Urban Water Management Plan Demand Management Measures Reporting and Requirements (DWR, 2013). The report notes that substantial system losses are commonplace, and recommends that for the 2015 Urban Water Management Plan update, water utilities quantify their distribution system water losses a minimum period of one year prior to 2015. For all subsequent UWMP updates, water utilities would report the distribution system water loss for each of the five years preceding the plan update. If these recommendations are adopted, the

method for quantifying the distribution system water loss would be reported in accordance with a standardized worksheet based on the water system balance methodology (water audit software) developed by the American Water Works Association. Several of the water retailers in the Santa Clara Plain using SFPUC Hetch Hetchy water are already carrying out loss reporting by this standard following best management practices promoted by the California Urban Water Conservation Council.[32]

A-4.1.4.8 Managing Swimming Pool Water

Swimming pools must be drained occasionally to allow pool maintenance. Pool water has elevated chlorine, which converts to chloride and can contribute to salt loading. To prevent discharge to creeks, ordinances and public information campaigns guide the public to discharge to sewer cleanouts instead of storm drains. Because most creeks also recharge groundwater, and sewer lines transmit their contents with only minor losses, mandating sewer line discharge of pool water and prohibiting storm drain discharge of pool water will control and reduce salt loading to groundwater. SCVURPPP has prepared educational brochures to be placed in pool supply stores and community centers. Many city ordinances expressly prohibit the discharge of chlorinated pool water to storm drains. These outreach programs and controls are particularly important in view of the trend toward saltwater swimming pools and chlorine free pool systems that rely on copper and silver biocides and algaecides.

A-4.1.4.9 Water Softener Technology Improvements

Water softeners that require dosing with salt for regeneration contribute substantial amounts of salt to wastewater, which in turn contributes to higher TDS in recycled water. Most water softeners are ion-exchange resin bed systems. Water softener resin beds exchange sodium or potassium on the resin for magnesium and calcium in the treated water, thereby reducing water hardness. The ongoing exchange increases the total sodium in the wastewater from businesses and homes that use water softeners. Water softening resins use sodium chloride brines for regeneration. The quantity and rate of addition of salt to water softening systems can be used to predict the total loading of salt to the sewer system. Reducing salt use by water softeners is a strategy employed to control the salinity of recycled water. Timer-based water softeners are regenerated twice as often as demand-initiated regenerations, and therefore use twice as much salt. Substituting potassium for sodium can also improve the quality of recycled water, increasing its suitability for landscape irrigation however, the TDS contribution from regenerations would not change signficantly.

Rebate programs to motivate replacement of timer-based water softener regeneration with demand-initiated regeneration are effective at lowering both salt discharge to the sewer and total water use. In 2003 and 2004, the District conducted a pilot program to issue rebates to residents who upgrade their water softeners to more efficient models. The pilot program issued rebates for 400 water softeners, saving an estimated 1.2 million gallons per year, and reducing salt discharge by approximately 120 tons per year (SCVWD, 2006).

A survey of Santa Clara County residential water use in 2004 found that 17% (± 3.6%) of the 410 single-family residences canvassed and 3% (± 2.3%) of the 187 multi-family residences canvassed used water softeners. The survey identified 71% of single-family residences using self-regenerating water softeners and 40% of multi-family residences using self-regenerating water softeners. Extrapolated over the many single-family and multi-family residences overlying

[32] http://www.cuwcc.org/resource-center/resource-center.aspx

the Santa Clara Plain, there is a large number of water softeners in use, representing a significant potential for reducing wastewater influent salinity content, as enumerated in Table 48. On average, each water softener dischages about 3 pounds salt per day to the sewer (SCVWD, 2006).

The City of San Jose commissioned the *South Bay Water Recycling Salinity Study* to assess salt discharges to the sanitary sewer (RMC, 2011). The study included:

- Sample collection (composite samples) and laboratory analysis of key industrial dischargers with high flows and/or suspected high salinity discharges.
- Continuous conductivity monitoring of the influent flows at the WPCP for a one month period.
- Continuous conductivity and flow monitoring (in the collection system) of representative residential and commercial sites around the tributary area to better understand residential consumptive use, residential water softener use, and the commercial contribution of key commercial categories. Conductivity monitors were installed for a one week period at each site.
- Hourly composite sample collection and laboratory analysis of TDS at a key pump station in Alviso, using a 24-hour sample collector. Hourly samples were collected for a four day period at the site.

The continuous monitoring of wastewater TDS determined that about 70 mg/L of wastewater TDS is contributed by water softener discharges, as depicted in Figure 46 (RMC, 2011). The data show periodic spikes in wastewater TDS concentration which reflect discharges from timer-based water softener regeneration,

The 2011 South Bay Water Recycling Salinity Study also estimated the total salt discharges to sewers from self-regenerating water softeners. The estimate used three approaches:

- Alternative 1: Water Softener Load Based on Survey of Bags of Salt Used Per Month.
- Alternative 2: Water Softener Additions Estimated from Collection System Monitoring.
- Alternative 3: Water Softener Worksheet Estimate of 35.3 mg/l TDS added area wide.

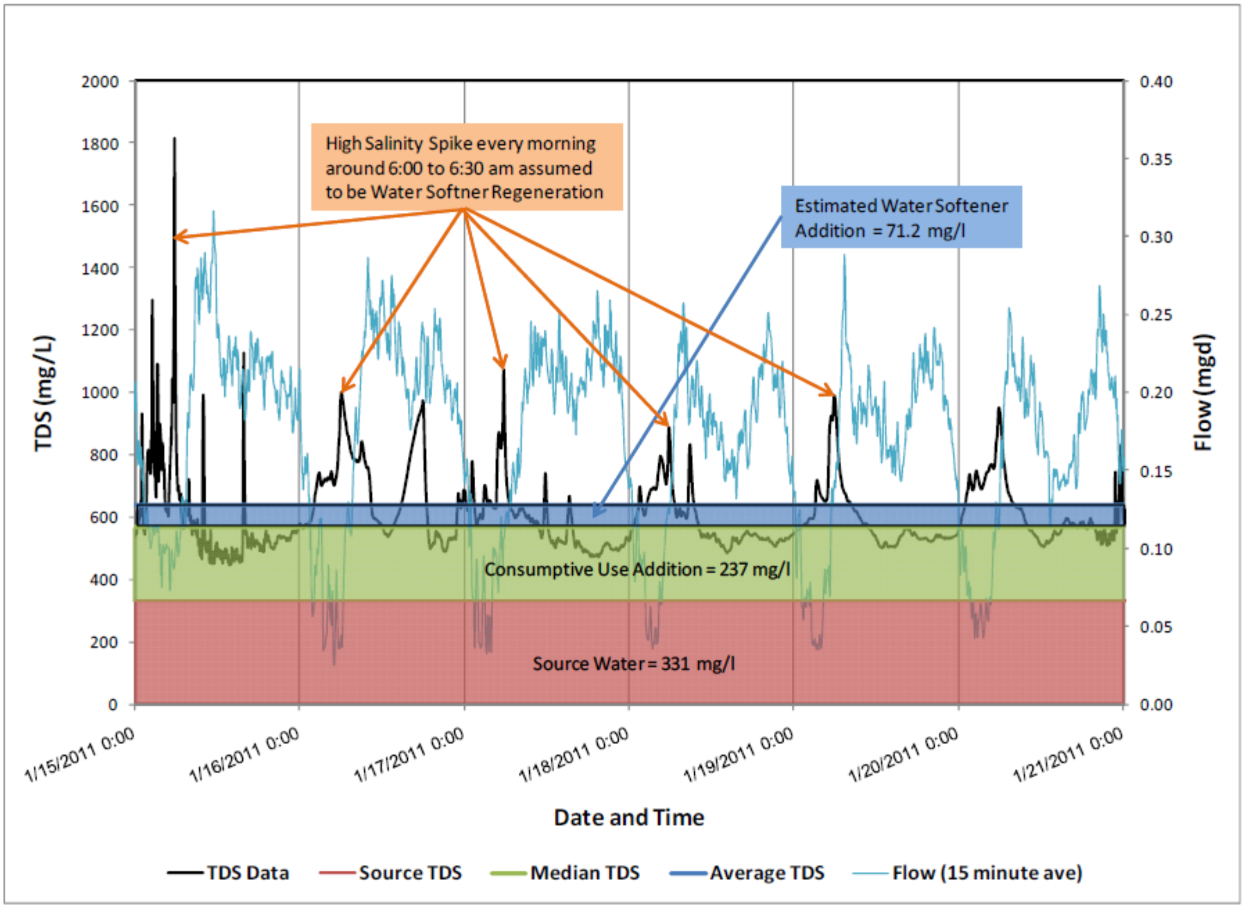

Figure 46- Interpretation of Continuous Wastewater TDS Monitoring Data (RMC, 2011)

The salt discharge estimates from the three methods were integrated with the District's 2004 survey of water softener use. In conjunction with housing metrics (i.e., single family and multifamily dwelling units) for the City, an estimated 10% of San Jose households in the tributary area are assumed to have self regenerating water softeners (RMC, 2011). The estimate based on survey data for salt use varies substantially from the estimates based on collection system monitoring data and on the water softener worksheet basis:

Table 47 – Estimates of Water Softener Discharge in SJ-SC WPCP Tributary Area

Method for Estimating Water Softener Discharge to Sewer	Salt Added in SJ-SC WPCP Tributary Area (as TDS)
1. Water Softener Load Based on Survey of Bags of Salt Used Per Month	22,200 tons/yr
2. Water Softener Additions Estimated from Collection System Monitoring	4,200 tons/yr
3. Water Softener Worksheet Estimate of 35.3 mg/l TDS added area wide	4,400 tons/yr

Data from RMC 2011. Estimates were carried across 410,546 homes.

The confidence level in all three estimates is low due to the variability of source water quality and numerous variables that impact water softener regeneration however, methods 2 and 3 are in relatively close agreement. The San José-Santa Clara Regional Wastewater Facility (SJ-SC RWF) tributary area covers about three quarters of the area of the Santa Clara Plain. Applying these assumptions for all the households within incorporated cities (and presumably on sewer) for the enitire Santa Clara Plain, gives the following results:

Table 48 – Estimates of Water Softener Discharge in Tributary Areas for All 3 POTWs

Method for Estimating Water Softener Discharge to Sewer	Salt Added in SJ-SC WPCP, Sunnyvale WPCP, and Palo Alto RWQCP Tributary Areas
1. Water Softener Additions Estimated from Collection System Monitoring	5,610 tons/yr
2. Water Softener Worksheet Estimate of 35.3 mg/l TDS added area wide	5,880 tons/yr

Based on 548,412 households (US Census 2010 – by city) exclusive of homes on sewer in the unincorporated county areas. This estimate may be in error where homes inside city limits are on septic or where homes in the unincorporated area are connected to sewers.

New technology for salt free water softening using physical, rather than chemical methods is now commercially available. Electromagnetic and electrically-induced precipitation devices can reduce scale formation by approximately 50 percent. Another approach called template-assisted crystallization reduces scale formation by greater than 90 percent. While none of the municipalities in Santa Clara County have prohibited conventional water softeners, some communities such as Santa Clarita Valley in southern California have already banned the use of ion exchange water softeners to improve wastewater quality for water reuse applications. The development of viable, salt free alternatives is a critical step toward eliminating brine discharges to wastewater. A few of the commercially available salt free water softeners are listed here:[33]

- Pelican NaturSoft
- Next Filtration Technology – nextScaleStop
- LifeSource Water System – ScaleSolver
- NuvoH20 – Home Salt-Free Water Softener
- Aquasana SimplySoft
- Eddy Electronic Descaler
- AQUA REX
- AQUA EWP
- BIOSTAT2000

Industries also use water softeners and reverse osmosis systems to condition water for various industrial applications. Reverse osmosis systems can also be a source of salinity in wastewater because 15 to 20% of the water treated is rejected to the sewer, bearing salts at five to seven times the initial TDS of the source water. Similarly, some cooling towers used in factories and

[33] No commercial product endorsement is implied. The Santa Clara Valley Water District has not tested these systems and cannot recommend one system over another. Other systems not listed here may be equally effective.

other facilities discharge evapo-concentrated wastewater that may carry as much as seven times the source water salinity content to the sewer.

The 2011 South Bay Water Recycling Salinity Study estimated industrial salt discharge to sewers using data from the 2007 US Economic Census to determine the number of each of these commercial businesses that are located in the tributary area. Water use data from each type of business was obtained from the 2006 City of Santa Clara Sewer Capacity Analysis to estimate average commercial sewer flows by industry type. TDS values for each of the types of commercial businesses were added from 2011 sewer monitoring data, if available, or from the report, "Characterizing and Managing Salinity Loadings in Reclaimed Water Systems" (WateReuse, 2006).

Several city ordinances include provisions limiting the discharge of salt to the sewer. For example, the City of Mountain View's City Code (§35.33.13.3) requires that the average TDS of discharges to the sewer not exceed 5,000 mg/L, and the maximum TDS not exceed 10,000 mg/L. Industrial pretreatment inspections may test for specific conductance or sample for TDS to check for compliance however, compliance testing is not usually conducted for residential dischargers.

A-4.2 Future Measures and Activities to Mitigate and Remove Salts and Nutrients

Future developments that are incorporated into long range plans or are under consideration can change the S/N balance in the Santa Clara Groundwater Subbasin. Over the 25-year planning horizon for SNMP, it is likely that some plans and forecasts will not materialize, while other developments may occur that have not yet been anticipated. This section examines the potential impacts of planned and foreseeable changes to the S/N balance in the Santa Clara Groundwater Subbasin.

A-4.2.1 Advanced Treatment of Recycled Water

Recycled water produced at the South Bay Water Recycling, Sunnyvale WPCP, and Palo Alto RWQCP has TDS ranging from 725 to 865 mg/L. Construction of the Silicon Valley Advanced Water Purification Center (SVAWPC) adjacent to the SJ-SC RWF was completed in 2013, and the system began operating in March 2014. Plans are under consideration for additional treatment at both the Sunnyvale WPCP and the Palo Alto RWQCP, which will improve the quality of recycled water by lowering TDS.

A-4.2.1.1 Silicon Valley Advanced Water Purification Center

The SVAWPC is designed to treat tertiary treated recycled water to produce 8 million gallons per day of low-TDS water.[34] Salts are removed using micro-filtration and reverse osmosis, and pathogens are removed using ultraviolet light. The highly purified water produced at SVAWPC will have an average TDS concentration of around 40 milligrams per liter. The addition of this purified water to tertiary-treated recycled water from South Bay Water Recycling will reduce the TDS levels from the current average of 725 mg/L to 500 mg/L for irrigation, and to 50 mg/L or less for indirect potable reuse (augmenting managed aquifer recharge). The reduction in TDS from advanced treatment of recycled water for irrigation and indirect potable reuse is incorporated into the assimilative capacity projections presented in Section 3.3.5.3.

[34] The 8 MGD figure is the current capacity as constructed. Future capacity can be achieved by expanding SVAWPC with additional storage and treatment capacity. The SVAWPC facility was designed to accommodate future expansion.

One of the goals of the Water Supply Infrastructure Master Plan is to provide advanced treated recycled water for blending with local reservoir water to produce 20,000 AF/yr of indirect potable reuse (IPR) by 2030 (SCVWD, 2012). Using recycled water for IPR will replace the imported water currently used for some recharge ponds. Advanced treated water may be blended with local reservoir water or used directly, depending on the logistical constraints at the recharge facilities slated for future IPR. The quality of advanced treated water used for IPR will depend on several factors including operational capacity, availability of local reservoir water for blending, blending ratios, and the quality of advanced treated water produced at SVAWPC. The quality of IPR water recharged to groundwater can range from 40 mg/L to 500 mg/L TDS.

Advanced water purification provides another new opportunity for recycled water use as a raw water source for drinking water treatment. Advanced treated water is free of pathogens and has low dissolved solids. With modifications, constituents of emerging concern such as NDMA, 1,4-dioxane, and perfluorinated, compounds can also be removed. Advanced water purification is capable of producing high-quality water that consistently and reliably meets the California Department of Public Health Title 22 Drinking Water Standards. It is therefore a natural fit to integrate this high-quality, drought proof drinking water source into the District's drinking water treatment and treated water distribution system. Incorporation of advanced treated recycled water into drinking water treatment is referred to as Direct Potable Reuse (DPR). Planning for DPR adds operational flexibility to decrease reliance on imported water whose availability is subject to change in the event of prolonged drought, levee or pump failure, or seismic disruption.

For planning purposes, a 50:50 blend scenario was evaluated. A 50:50 blend of advanced treated water at 50 mg/L TDS and current sources of recharge (volume-weighted average TDS of 286 mg/L) will produce recharge water quality of 168 mg/L TDS. Table 49 presents the forecasted future assimilative capacity under this scenario.

Table 49 – Changes to Assimilative Capacity for the 50:50 Blend IPR Scenario

Scenario	2035 Santa Clara Plain TDS, mg/L	2035 Assimilative Capacity	Rate of TDS increase, mg/L/year
Baseline	456.8	43.2	1.23
TDS = 168 mg/L	456.0	44.0	1.20

A-4.2.1.2 Sunnyvale Recycled Water Improvements

The Sunnyvale WPCP produces tertiary-treated recycled water with a TDS of approximately 870 mg/L (TDS ranged from 771 to 965 mg/L between 2002 and 2011). Plans for additional treatment would reduce TDS to 760 mg/L in 2023, and increase the volume of recycled water produced for landscape irrigation. The future reduced TDS for recycled water produced at Sunnyvale WPCP is incorporated into the projections shown in Section 3.5.3.3.

A-4.2.1.3 Palo Alto Recycled Water Improvements

The Palo Alto RWQCP Clean Bay Pollution Prevention Plan describes a Phase III recycled water expansion project to add 5,500 AF/yr of recycled water irrigation by 2027. Up to 915 AF/yr additional expansion may occur in the current Phase II, which is not yet serving at full capacity. Changes to recycled water treatment are not planned within the 25-year planning horizon for SNMP however, Palo Alto's Long Range Facilities Master Plan mentions advanced

treatment of recycled water using ultra-filtration and reverse-osmosis by 2050 (City of Palo Alto, 2012).

A-4.2.1.4 Dual Plumbing with Recycled Water

New developments present the opportunity to incorporate recycled water into household plumbing so that toilets are flushed using recycled water. Toilets use a minor portion of total indoor water use (10 – 20%), and only a small fraction of recycled water production is projected for indoor purposes (3%). The effect of indoor uses for recycled water is to conserve treated drinking water, which also increases the salinity of wastewater and in turn can increase the TDS concentration of tertiary-treated recycled water. Because the volumes in question are small (~ 1,400 AF/yr in 2035),[35] dual plumbing of recycled water was not incorporated into future loading analysis.

A-4.2.3 Wastewater Infrastructure Improvements

As discussed in Section 3.2.3.4 (Groundwater Infiltration into Sewer Lines), where sewer mains are buried below the water table, groundwater may flow under hydrostatic pressure into the sewers through defective joints, cracks, or other openings. The shallow groundwater condition where sewer lines are submerged is found near the bay, where groundwater is locally saline.

Infiltration of saline groundwater into sewer lines contributes a significant amount of salt to wastewater, and recycled water may have elevated TDS as a result. Projects to reduce intrusion of saline groundwater to sewer lines favor better quality recycled water.

One such project, funded and managed by the City of Mountain View, upgraded the Mountain View Trunk Line, which carries wastewater to the Palo Alto Regional Water Quality Control Plant and is located within an area of highly saline groundwater. The Mountain View Trunk Line was resleeved[36] in 2013, reducing TDS in recycled water from 950 to 775 mg/L. This trunk line contributes 31% of the 21.7 MGD total flow to the Palo Alto Regional Water Quality Plant. Additional capital improvements to wastewater infrastructure in Mountain View and Palo Alto are expected to achieve a reduction in recycled water TDS from the present 775 mg/L to 600 mg/L by 2022. Resleeving sewer mains will also result in a reduction in salt removal of 2,240 tons TDS per year. The reduction in salt loading from Palo Alto recycled water and the reduction in salt removal from saline intrusion into sewer lines are incorporated into the forecasts presented in Section 3.3.5.6.

In recent years, the City of Sunnyvale completed a major sewer trunk line rehabilitation project on Borregas Avenue, and the City of San Jose has been following a maintenance-driven schedule of sewer line repairs and replacements. To the extent that these improvements reduce intrusion of saline groundwater to sewer lines, a reduction of recycled water TDS will result.

The City of San Jose sanitary sewer system consists of approximately 2,250 miles of sewer mains ranging in diameter from 6 to 90 inches, and includes 16 pump stations. San Jose has identified potential improvements to recycled water quality from rehabilitating sewer mains where intrusion of saline groundwater occurs. The 2011 South Bay Water Recycling Salinity

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[35] This volume equates to about 1.2 million gallons per day, which is less than 1% of the current wastewater treatment capacity at the SJ-SC WPCP, and a still smaller fraction of 2035 wastewater treatment capacity.
[36] Resleeving a pipe involves inserting a smaller diameter intact pipe inside a larger diameter defective pipe or inserting a flexible epoxy liner that is cured to form a rigid and durable pipe.

Study reports monitoring results for a site was selected in Alviso for hourly sampling of wastewater TDS over a 4-day period. The results show TDS ranged from 7,000 to more than 30,000 mg/L, and visible groundwater intrusion was observed in the course of the test. The total annual salt load from intrusion of saline groundwater at this single Alviso manhole, after subtracting source water quality and consumptive use salinity, was 1,250 tons per year (RMC, 2011). The City of San Jose's 2014-2018 Capital Improvement Plan identifies 17 major sewer improvement projects, including the Alviso section studied in 2011. The City plans to spend $2 million to upgrade sections of sewer mains in Alviso by mid 2016, which is also expected to eliminate significant salt addition to wastewater from intrusion of saline groundwater.

Stanford University also conducts routine video monitoring of campus sewer lines, and has an ongoing Capital Improvement Project to replace aging and deteriorating sewer pipes.

A-4.2.4   Managed Recharge Infrastructure Improvements

The District currently operates 393 acres of recharge ponds and 91 miles of controlled in-stream recharge. Water used for managed recharge comes from three sources: 1) imported water 2) local reservoirs and 3) stormwater runoff. As described in Sections 3.2.1.4 and 3.2.1.5, the volume-weighted average recharge water concentrations are 191 mg/L and 0.6 mg/L for TDS and nitrate in the Santa Clara Plain, and 238 mg/L and 0.36 mg/L for TDS and nitrate in Coyote Valley. Capital projects are underway to improve three diversion dams for recharge ponds in the Santa Clara Plain. As described in Table 38, the improvements will allow more flexible operations that will increase the number of days per year that flow in streams is partially diverted to fill recharge ponds. Replacing flashboard dams with inflatable dams allows quicker dam removal with less labor, so that the dams can remain in place longer before storm events and releases from upstream dams require dam removal. The estimated increased recharge capacity from these improvements at three diversion dams is 11,800 AF/yr (SCVWD, 2010). The projects will be completed in 2014, 2018, and 2020. However, the addition of recharge capacity does not directly translate into increased volume of groundwater recharge. If the subbasin is in a relatively full condition, recharge operations are typically scaled back. Similarly, recharge operations are typically scaled back when surface water supplies are limited.

In addition to new capacity from diversion dam improvement projects, the Water Supply and Infrastructure Master Plan identifies increased recharge capacity from constructing new recharge ponds in the western Santa Clara Plain. The yield from the new ponds is projected to be about 3,300 AF/yr. The recharge ponds could be located on the west side of the valley, along Saratoga Creek near Highway 85 (SCVWD, 2012). For planning purposes, we assume that on average, 20% of the increased capacity created by the dam diversion improvements, and 50% of new recharge facility capacity is used, i.e., the net additional recharge for determining loading is 4,000 AF/yr. We further assume that all of the additional recharge would be with local sources and not advanced treated recycled water. This increased recharge is incorporated into the projections in Section 3.3.5.2.

A-4.2.5   Imported Water Quality Improvements

As shown in Figure 47, water imported for treatment and/or distribution to retailers comprised about 182,000 AF in 2013, which is about 48% of the water used by retailers and other beneficial uses (SCVWD, 2013a)[37]. Even though imported water is of good quality with low

[37] Includes water used for banking outside Santa Clara County and Hetch Hetchy water from SFPUC, and excludes imported water used for recharge.

TDS in many years, any improvements to imported water quality will produce a significant reduction of overall loading. Imported water quality is controlled by conditions in the south Sacramento-San Joaquin Delta, where pumping stations convey runoff from the Sierra Nevada Mountains to the State Water Project and Central Valley Water Projects (SWP and CVP). The Bay-Delta Conservation Plan (BDCP) includes alternative water conveyance arrangements that could improve protection of sensitive fish species in the Delta and reliability of water supplies. The new conveyance facility would withdraw water from further north in the Delta, where salinity levels are lower than in the south Delta.

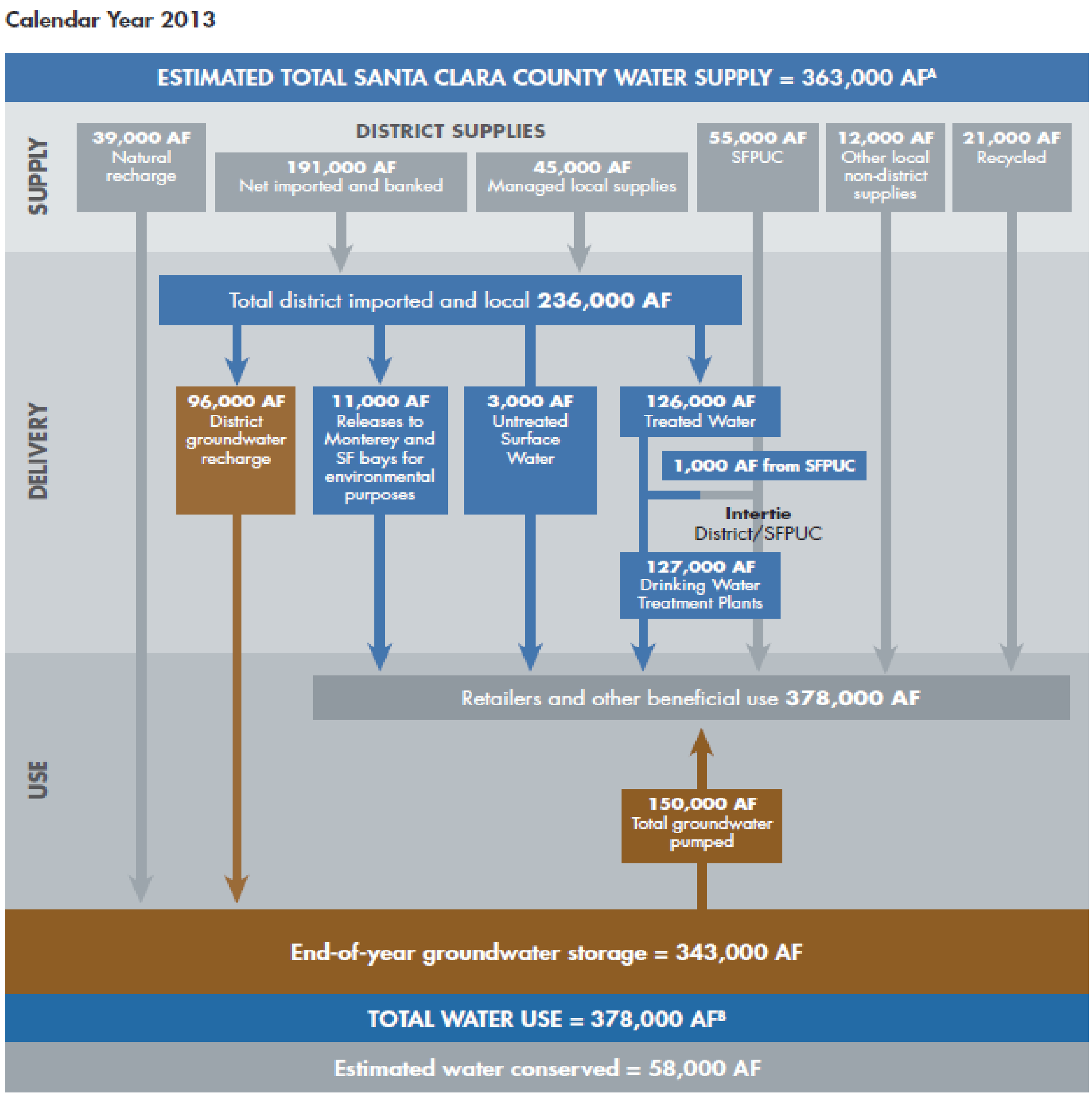

Figure 47 – 2013 Water Supply

A Includes net district and non-district surface water supplies and estimated rainfall recharge to groundwater basins.

B Includes municipal, industrial, agricultural, and environmental uses.

Operation of the proposed new north delta intakes is anticipated to decrease the average annual TDS of SWP and CVP Delta exports by about 22 percent under the BDCP proposed project when compared with the BDCP future “no action” scenario (SCVWD, 2013b). This would reduce the salt loading of deliveries to the District’s three drinking water treatment plants, and to the District’s managed groundwater recharge program. Current drinking water treatment plant processes cause minor increases in the salt content of the source water.[38] Any improvement in the salinity of source water translates to a reduction in salt loading from landscape irrigation and managed recharge as well as lower-TDS recycled water at plants without advanced treatment. Reducing the TDS of imported water by 22 percent would reduce the amount of salt loading to the basin through landscape irrigation, managed recharge, and conveyance losses by approximately 9,300 tons per year. Because the outcome of BDCP is not yet known, this reduction in salt loading was not incorporated into the future loading projections.

A-4.3 Future Assimilative Capacity Changes from Additional Groundwater Quality Management Programs and Other Changes

The majority of the water quality management strategies identified in Sections A-4.2 and A-4.3 are programs and measures that are already being carried out. The benefit of existing programs is incorporated into the projections for future assimilative capacity. Future changes that are not yet incorporated into the projection include the following categories described in Section A-4.2.

- As yet unidentified rehabilitation of sewer lines where intrusion of saline groundwater occurs (would improve quality of tertiary-treated recycled water).
- As yet unplanned conversion of brine-regenerated water softeners to no-salt alternatives.
- Imported water quality improvements.
- As yet unidentified changes to recycled water quality and quantity, e.g., Palo Alto adopting advanced treatment before 2050.

The effect that these changes may have on future assimilative capacity is difficult to estimate quantitatively due to the lack of detailed information on key parameters. However, a qualitative assessment can be made, with a comparison of which future measures will lead to larger or smaller changes in future assimilative capacity. A qualitative comparison of possible future scenarios is shown in Table 49.

[38] Drinking water treatment disinfects imported surface water and removes suspended solids, but is not designed to remove salt. The treatment processes used to disinfect the water and remove natural organic matter add salt to treated water. The 10-year average increase of median TDS in treated water compared to raw water at Penitencia, Santa Teresa, and Rinconada Water Treatment Plants is 7.8%, 4.1%, and 10.3%, respectively.

Table 50 – Comparison of Qualitative Changes to Future Assimilative Capacity from Unquantified Potential Changes to Future TDS Loading

Prospective Change	Change in Future Loading from		Change in Future Assimilative Capacity
Sewer Line Rehabilitation to mitigate infiltration of saline groundwater	Recycled Water	↓	↑ Decreased recycled water loading = increased assimilative capacity
Sewer Line Rehabilitation to mitigate exfiltration	Drainage Losses	↓	↑ Decreased loading = increased assimilative capacity
Lower-TDS Recycled Water Irrigation (i.e., <500 mg/L)	Salt Loading	↓	↑ Decreased loading = increased assimilative capacity
Water Softener Conversion to No-Salt Alternatives	Recycled Water TDS Drainage Losses	↓ ↓	↑ Decreased loading = increased assimilative capacity
Improved Quality of Imported Water	Outdoor Irrigation Managed Recharge Conveyance Losses Recycled Water	↓ ↓ ↓ ↓	↑ Decreased loading = increased assimilative capacity

Size of arrows indicate relative magnitude of change

Not included in Table 49 is any change to rainfall and evapotranspiration that may occur due to climate changes such as prolonged drought or prolonged periods of cooler and wetter conditions. Like many other hydrologic forecasts, future projections for this SNMP make the assumption of stationarity, i.e., that the natural systems controlling natural recharge fluctuate within an unchanging envelope of variability. The stationarity assumption is widely considered to be inadequate for managing water resources, in view of anthropogenic changes in recent decades that influence hydrologic outcomes (Milly, et al., 2008). These anthropogenic changes did not influence earlier records of rainfall or other climate factors, so assuming that early climatic patterns will persist (assuming stationarity) may be ignoring a long-term or near-term shift in rainfall, temperature, evaporation, etc. The alternative is detailed stochastic modeling of hydrologic responses to future climate scenarios predicted by global-scale climate models, which are also limited by inherent uncertainty. It is beyond the scope of this SNMP to engage in "Monte Carlo" style conditional simulations of future salt-loading outcomes in response to prospective future hydrology scenarios.

APPENDIX 5

Groundwater Infiltration to Sanitary Sewers and Storm Drains

Groundwater Infiltration to Sanitary Sewers and Storm Drains

The magnitude of groundwater infiltration (GWI) to sanitary sewers can be estimated by several different methods. These include:

1. Applying estimates generated by sanitary system operators (SSOs).
2. Applying literature values for infiltration based on the diameter of the pipes within the areas where the water table is above the pipes.
3. Applying literature values for infiltration based on the number of acres or sewered areas within the zone of high groundwater (applies to sanitary sewers only).
4. Contrasting wet season and dry season baseline flows and subtracting estimated total wastewater based on per capita wastewater generation literature values and census data (applies to sanitary sewers only).

Estimates of GWI to storm drains were made using method 2. To increase confidence in the GWI estimate for sewers currently used in the District's flow model, estimation methods 2 and 3 above were carried out for sewers and compared. The results are shown in Table 51.

Sewer GWI Estimates Generated by Sanitary System Operators

The City of San Jose estimated GWI into the Santa Clara-San Jose (SJSC) sanitary sewer system in 1992. This estimate (5,600 AF/yr) has been used for the District's groundwater flow model and is about 4.5% of the 10-year median SJSC-WPCP flows in 2001-2010 (CH2M Hill, 1992). The same ratio was applied to the inflow volumes for the Palo Alto and Sunnyvale wastewater plants to arrive at a total estimated GWI into sewers of 7,520 AF/yr.

To determine the amount of salt removed by this GWI estimate, we applied the locally interpolated average TDS concentrations for groundwater in the shallow aquifer. The Coyote Valley is not served by a sanitary sewer system, so there is no salt and nitrate removal by this mechanism. The SSO estimate includes GWI within the zone of saline intrusion north of the 100 mg/L chloride contour, which was also excluded from the SNMP loading analysis. The value may therefore over-estimate the salt removal within the domain of the SNMP analysis.

Sewer GWI Estimates Using Literature Rates Based on Pipe Diameter

Typical sewer laterals are constructed at depths 4 feet for houses on slabs and 8 feet for houses with basements. Sewer mains are typically constructed 8 to 10 feet below ground.

Sewer mains are most commonly located beneath streets; hence, street maps are a suitable surrogate for sewers in the Santa Clara Plain. The distribution of sewer line materials, diameters, and ages from available sanitary system data was applied to the street surrogates for sewer lines in all areas subject to GWI. This approach excludes sewer laterals on private property, which are generally assumed to be above the water table. The portion of the sewer system residing in the area where depth to water was 10 feet or less was selected for the infiltration evaluation.[39] The following assumptions and approximations are made for estimating GWI in the zone with depth to water less than 10 feet (exclusive of the saline intrusion zone):

[39] Depth to water was mapped for the principal aquifer for the Fall of 2002. Spring depth to water is generally shallow so that the area with depth to water less than 10 feet is larger. To capture year-round infiltration and dry years, the

- The rate of GWI used, 100 gpimd,[40] represents the majority of the system and corresponds to the 65% of pipes older than 45 years (EPA, 1971).
- 1/3 of the area has year-round GWI.
- 2/3 of the area has GWI from December through April (150 days, or 41%).
- Roads classified as “Class 1” (e.g., freeways) are assumed not to represent locations of sewers.
- 95% of sewer pipes are made of vitrified clay pipe (VCP).
- The distribution of VCP diameter in all areas follows the general pattern for sanitary systems with available data:

6"	65%
8"	20%
10"	5%
12"	3%

- Pipes older than 45 years infiltrate at 10 times the estimated exfiltration rate.
- Pipes between 45 years and 25 years old infiltrate at 5 times the estimated exfiltration rate.
- Pipes between 25 years and 15 years old infiltrate at the same rate as assumed exfiltration.
- Pipes younger than 15 years old have no infiltration.
- The ~5% of sewers made of materials other than VCP (e.g., ductile iron pipe, PVC pipe, HDPE pipe, reinforced concrete pipe) may be larger in diameter but are generally less vulnerable to infiltration and are ignored for this analysis.

The result of combining these assumptions is shown in Table 51.

Sewer Line Infiltration Estimates Based on Area Methods

GWI into sewers is sometimes estimated based on acres of development. For example, the City of Santa Clara Sanitary System Management Plan uses design criteria of 1,000 gallons infiltration per acre per day (gpad) for construction north of Highway 101, and 750 gallons per acre per day for construction south of Highway 101 (City of Santa Clara, 2010).

Because it is difficult to predict GWI rates based on physical system data alone, estimates of GWI based on actual flow monitoring data are considered more reliable. The City of Santa Clara estimated GWI based on minimum flows during non-rainfall periods and during a wet weather flow monitoring period. Minimum flows typically occur at night or during early morning hours when base wastewater flows are lowest. GWI can also be estimated as the difference between average metered flows during non-rainfall periods and computed average base

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Fall groundwater depths were used to estimate the portion of the system in which infiltration may occur. The principal aquifer is used as a surrogate for the water table however, that assumption may not be valid where there is a cone of depression or upward vertical gradients outside the artesian zone.

[10] gpimd = gallons per inch diameter per mile of sewer per day

wastewater flow. In either case, the resulting GWI is expressed on a unit basis (gpd/acre or gpad) by dividing by the sewered acreage of the monitored area. Typical GWI rates may range from 100 to over 1,000 gpad (City of Santa Clara, 2010). The assumed GWI for this SNMP is 250 gpad in areas with year-round infiltration, and 100 gpad in areas with infiltration occurring only from December through April. One-third of the area mapped in Fall 2002 as 0 to 10 ft depth to water is presumed to have year-round GWI, while two-thirds is presumed to have GWI from December through April.

The result of the area-based estimation method is included in Table 51, below.

Table 51 – Comparison of 3 Different Methods to Estimate Groundwater Infiltration to Sewers

	System Operator Estimate*	Literature Rates, Pipe Diameter Method**	Santa Clara Area Method
Groundwater Infiltration	7,520 AF/yr	2,930 AF/yr	3,500 AF/yr
TDS removed	6,550 tons/yr	2,520 tons/yr	3,130 tons/yr
Nitrate removed	56 tons/yr	28 tons/yr	16.2 tons/yr

* includes areas in zone of saline intrusion that are excluded from SNMP loading analysis.

**this method was selected for estimating GWI

The difference between the SSO estimate and the pipe diameter and area methods may be due to a combination of:

- The inclusion of areas excluded from SNMP analysis in the SSO estimate.
- Use of factors that may be too low (e.g., 100 gpidm instead of 150 or higher).
- Using Fall depth to groundwater contours instead of Spring. These choices are made to ensure that salt and nitrate removal by GWI is not over-estimated to avoid understating the long-term effects of salt and nitrate loading.

The area method may overstate the magnitude of GWI because land uses were not differentiated when selecting the area within the zone of shallow groundwater where sewer lines are submerged. Accordingly, the pipe diameter method was selected for estimating GWI.

Storm Drain Infiltration

Storm drains in both the Santa Clara Plain and the Coyote Valley may remove groundwater where they are submerged year-round or seasonally. To estimate the magnitude of groundwater infiltration into storm drains, an estimate of exfiltration was developed and the ten-fold infiltration estimation factor described in 3.3.1.10 was applied.

Sanitary sewer lines made of concrete typically have an exfiltration rate of less than 200 gallons per inch of internal diameter per mile of sewer over 24-hours (ASTM C 969). For this analysis, we assume that the rate is 100 gallons per inch of internal diameter per mile (gpidm) of sewer length over 24 hours. Applying this leakage rate to an average 3,000-ft reach of concrete storm sewer with a diameter of 60-inches, the rate of stormwater loss would be 4,380 gallons per day.

Storm sewers however, are not held to the tight leakage standards required of sanitary sewers so the rate of exfiltration could be greater.

For sanitary sewers, we assume that exfiltration is 10% of infiltration. Exfiltration usually occurs when the pipe is carrying less than total capacity and has lower pressure head driving the leakage. When a storm drain is submerged in groundwater, hydrostatic pressure drives groundwater into the pipe from all directions, resulting in a substantially higher flow of water into the storm drain.[41] For consistency, we also assume that groundwater infiltration into storm drains is 10-fold the rate of exfiltration.

The District has compiled GIS coverages of storm drain locations and lengths, and mapped the depth to groundwater (using Fall, 2002 as explained in 3.3.3.4). To estimate the length of storm drains that are submerged, the following simplifying assumptions are made:

- One-third of the storm drains within the mapped 0 to 10 feet depth to groundwater zone are submerged year-round.

- Two-thirds of the storm drains within the mapped 0 to 10 feet depth to groundwater zone are submerged seasonally, i.e., between December 1st and April 30th.

- The average diameter of all storm drains is 24 inches.

There are 371 miles of storm drains within the area mapped as 0 to 10 feet minimum depth to groundwater, exclusive of the “saline intrusion zone” where chloride exceeds 100 mg/L. The storm drains included in the groundwater infiltration estimate are shown in Figure 48. Applying the assumptions listed above, the 100 gpidm ASTM exfiltration factor, and the 10-fold infiltration assumption, the estimated annual groundwater infiltration to storm drains is 4,380 AF/yr. Using the volume-weighted average shallow groundwater concentration spatial distribution[42] for TDS, nitrate as nitrogen, and assigning concentrations to storm drain reaches, the annual salt and nitrate removal is estimated to be 3,200 and 46 tons per year, respectively.

[41] For example, the East Bay Municipal Utility District reports that during the rainy season, inflow and infiltration can lead to a 10-fold increase in the volume of wastewater that makes its way to EBMUD’s Main Wastewater Treatment Plant (EBMUD, 2013). Inflow refers to rainfall runoff entering sewers through manholes, while infiltration refers to movement of groundwater into storm drains that are positioned below the water table.

[42] See Section 3.4.2 for derivation of basin-wide volume-weighted average concentrations for the shallow and principal aquifers.

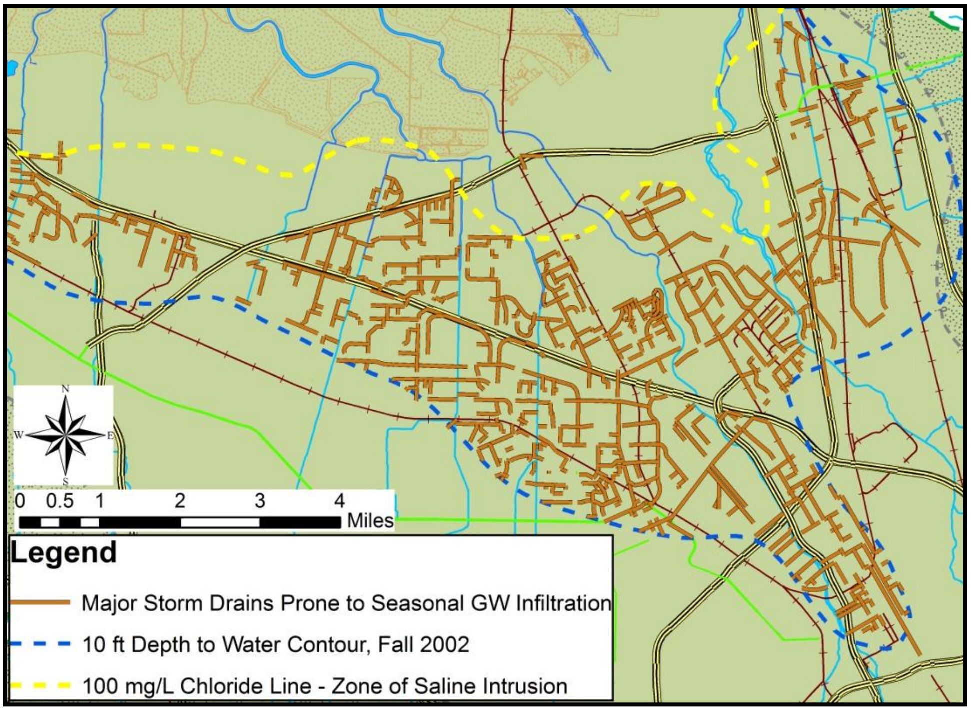

Figure 48 – Storm Drains Located in Zone of Minimum Depth to Groundwater Less than 10 Feet

NOTE: Zone of 10-foot depth to water approximated from elevations of groundwater pressure surface from principal aquifer mapped for Fall, 2002 and USGS land surface elevation contours. Storm Drain map may not reflect recent development in this area.

APPENDIX 6

San Francisco Bay Regional Water Quality Control Board Comments and District Responses to Comments

5750 Almaden Expressway, San Jose, CA 95118-3614 | (408) 265-2600 | www.valleywater.org

Santa Clara Valley Water District

May 15, 2015

Dr. Keith Roberson
San Francisco Bay Regional Water Quality Control Board
1515 Clay Street, 14th Floor
Oakland, CA 94612

Subject: Santa Clara Subbasin Salt and Nutrient Management Plan – Response to Regional Water Board and State Water Board Comments

Dear Dr. Roberson:

The Santa Clara Valley Water District (District) appreciates the Water Board's participation in the Salt and Nutrient Management Plan (SNMP) stakeholder process for the Santa Clara Subbasin. We received the Regional and State Water Boards' detailed and helpful comments on the Draft SNMP. This letter provides responses to your comments. The District has updated the SNMP based on comments received from the Water Board and basin stakeholders. The District has posted the updated report to our website, and will send you a hard copy for your reference. The District requests that the Water Board formally concur with the findings of the Santa Clara Subbasin SNMP.

Comments on Analysis Approach

1. *Please discuss the appropriateness of using the median as the best indicator of groundwater quality. A graph of the ranked median concentration by well from lowest to highest would be a helpful way to summarize the data and quickly see clusters and outliers.*

   Response: There is significant range in the groundwater quality data, which are not normally distributed due to a wide range of values for some parameters and low- and high-concentration outliers. As it represents the 50th percentile, or middle of the sample population, the median is the most robust value to represent the basin-wide groundwater quality, and is superior to the mean. The District reports median values for water quality data in the Annual Groundwater Report, which will also be used for SNMP monitoring reporting. For consistency, the District completed the SNMP analysis using median concentrations; however, basin-wide volume-weighted averages were used to assess assimilative capacity. A chart of ranked median concentration by well to show clusters and outliers would not retain the spatial component of the data, as not all wells monitor the same groundwater features (e.g. shallow vs. principal aquifer, Coyote Valley vs. Santa Clara Plain, recharge zone vs. confined zone, land use variation, etc.). A justification for using the median concentration was added to the SNMP.

2. *For the various salt and nutrient loading sources, was there any attempt to model the effects of loading based on where within the basin it occurs? For example, section*

3.3.1.8 discusses 6,725 tons of salt loading due to landscape irrigation with 6,640 acre-feet of recycled water. Was it assumed that all the salt load instantaneously mixes throughout the basin?

Response: Mixing assumptions and rationale are described in Section 3.4.4.2. To simplify calculations, salts and nutrients are assumed to mix completely throughout the saturated volume of the basin in the same year they are added. Due to this simplifying assumption, the geographic location of loading sources did not need to be modeled.

3. *Was salt and nitrate loading from septic systems accounted for? If so how? Is there a spatial component to it?*

   Response: Yes, loading from septic systems was included in the analysis under the loading category of “drainage losses” – see Sections 3.3.1.10, 3.4.5.4., and Figure 3-13a and b. The District added Figure 3-5 to show the general locations of septic tanks in the Santa Clara Subbasin.

4. *Section 3.4.2 (page 65) – Is there a particular reason that the volume-weighted average concentrations for the Santa Clara Plain and Coyote Valley were based on data from 2006-2010 when there appears to be ample data available for the period 2002 – 2012 as presented in Tables 2-2, 2-3, and 2-5?*

   Response: The District updated the volume-weighted average data in Tables 3-21 and 3-22 with the most recent five years of data available (2008–2012).

5. *What is the rationale for combining the shallow and principal aquifer zones of the Santa Clara Plain as one for net TDS and nitrate loading evaluation such as in Figures 3-13 and 3-13b? Figure 3-13 shows approximately a 30 mg/L TDS increase for these zones over 25 years based on the various loading assumptions. That’s about a 7% increase or use of assimilative capacity. Could this be determined for each aquifer zone independently?*

   Response: The Recycled Water Policy calls for comparison of basin assimilative capacity to Basin Plan water quality objectives. Because the Basin Plan does not distinguish between shallow and principal aquifers, a combined assimilative capacity approach was used. The SNMP findings indicate there is available assimilative capacity for both salts and nutrients, even under the conservative assumption of instantaneous, basin-wide mixing. While it is possible to assess available assimilative capacity separately for the shallow and principal aquifers with more time and effort, the results still need to be added to predict total consumption of assimilative capacity, which is the metric upon which the Recycled Water Policy is focused.

6. *For the Santa Clara Plain it appears that the largest increase in TDS loading is due to projected recycled water use over the next 25 years. Currently 6,600 acre-feet of*

recycled water is applied as landscape irrigation for a TDS loading of 6,700 tons. That's about 8% of the total TDS loading to the sub-basin. Over the next 25 years, recycled water use could increase to 16,000 acre-feet (Table 3-27) for a TDS loading of nearly 25,000 tons (Figure 3-9a). What percentage of total TDS loading would that constitute in 25 years?

Response: In 2035, the percentage of TDS loading contributed by recycled water is about 19% as shown in Table 3-29 (percentage is the ratio of TDS assimilative capacity consumed by recycled water to the total for 2035). However, to gage cumulative consumption of assimilative capacity over the 25 year evaluation period, the yearly TDS loading from all sources is divided by the basin volume and a revised basin TDS concentration is calculated. By 2035, 41% of available basin assimilative capacity is projected to be consumed by TDS loading from all sources, of which 6.2% is due to loading from recycled water irrigation in the Santa Clara Plain (see Table 3-29).

7. *Would the greatest loadings still be due to the managed recharge and landscape irrigation using non-recycled water sources?*

   Response: Yes. Bear in mind that the loading charts (e.g., Figures 3-9 through 3-13) show only half the balance, before accounting for the removal terms. Of the 41% assimilative capacity consumed, the portion consumed by recycled water is 15%, while the portion consumed by managed recharge and irrigation with distributed water is 73%. These percentages are derived from the ratios of the total assimilative capacity consumption in Table 3-29.

8. *The references for the literature used to estimate the nitrate attenuation factor seem to be pretty old. A better explanation of how the attenuation factors were arrived at would be a good addition.*

   Response: Most of the literature cited was published in the last three decades (and some in the last few years); the information used is still valid and relevant. The nitrate leaching estimate of 35% used in the SNMP is in reasonable agreement with a median value for leaching of applied nitrogen used in the 2012 UC Davis study on nitrogen sources and loading prepared for the State Water Board (30.2 percent).

9. *Some justification should be provided for using TDS as the sole indicator of salinity.*

   Response: As described in Section 2.5.1: "TDS is a comprehensive measure of all salts in groundwater, and is therefore used as the indicator parameter for salts in this SNMP. Tracking individual salts such as sodium, magnesium, or calcium is less informative for salt management because these solutes are subject to cation exchange with clays and other minerals, which may decrease concentrations of one solute while increasing another. The relative proportions of calcium, sodium or magnesium may change from geochemical reactions, but the TDS stays relatively constant and is therefore a more robust measure of salts in groundwater. Limitations to TDS measurement accuracy can make comparison of TDS analyzed by different methods difficult. However, the

consistent application of a single method employed for analysis of District samples makes TDS the best overall indicator of salt in groundwater for this SNMP."

10. *The Santa Clara Plain model was not calibrated to include a module for gaining reaches of streams. Some explanation or correction factor could be considered.*

    Response: Gaining reaches of streams are expected to occur in tidal reaches, which makes it difficult to gage streams with sufficient accuracy to discern volumes of groundwater discharge. Resolution of the water balance for the District's Santa Clara Plain flow model is made by adjusting other lumped terms from which gaining reaches of streams cannot be separated. Because the discharge of groundwater and associated salts and nutrients to streams is not included in the SNMP analysis, the estimates for net loading are conservative in terms of basin protection. In spite of loading estimates being biased high, projections show that the Santa Clara Subbasin does not accumulate enough salt in 25 years to exceed Basin Plan Water Quality Objectives.

11. *As far as assimilative capacity and baseline, these should be estimated with vertical boundaries (shallow and principal aquifers) because the loading happens in one or the other aquifer (usually the shallow) and groundwater does not mix the way they are assuming. The statement that simplifying assumptions have the effect of overstating the rate of salt accumulation is only partially true, because the rate of salt accumulation in the shallow aquifer is being underestimated. However, because the major sources of anticipated loading are irrigation and managed recharge, this may not be as critical because these sources lend themselves to potential controls.*

    Response: This SNMP was prepared using the groundwater basin boundaries described in the Basin Plan, which does not distinguish between the shallow and principal aquifers when considering beneficial uses. The best opportunity to curtail salt and nitrate loading in the subbasin is from conservation of water used for outdoor irrigation. Due to the extreme drought, the District has offered residents of Santa Clara County rebates for outdoor water conservation measures. Since 2013, these rebate programs have converted more than 1,380,000 square feet of residential lawns to drought-resistant landscaping and paid for smart irrigation controls, permanently reducing loading from irrigation. If implemented, measures in the Bay Delta Conservation Plan may also reduce the salinity of imported water, thereby decreasing loading from landscape irrigation using non-recycled water, and from managed recharge.

12. *Regarding potential controls, the document should include some implementation plan to lower salt loading in the Santa Clara Plain because the use of assimilative capacity in this basin is predicted to increase. This will be the main gist of the SNMP and will figure prominently in the decision to adopt a Basin Plan Amendment.*

    Response: The District has provided an inventory of ongoing programs and projects that limit or reduce salt and nutrient loading (Appendix 4). However, the conclusion of the SNMP analysis, which relied on conservative assumptions, is that Basin Plan Water Quality Objectives will not be exceeded within the 25 year planning horizon. Per the

Recycled Water Policy, a formal implementation plan is therefore not required (see Section 6.b.(2)). The Recycled Water Policy allows consumption of some assimilative capacity to enhance water supply reliability by supporting recycled water projects, particularly those that incorporate advanced treatment.

<u>Comments on Document Clarity (Text, Tables, Figures)</u>

13. *The resolution of Figure 2-2 is poor and could be improved to show the demarcation between the shallow and principal aquifers. According to footnote 1 the boundary is at the 150 foot depth.*

    <u>Response:</u> This Figure has been replaced with a better quality graphic. Additional lines and explanatory text were added to indicate that the approximate location of the 150 foot boundary between shallow and principal aquifer, and to advise that this demarcation is conceptual and not a clear geologic boundary that is consistently present in boring logs at all locations.

14. *On page 20 (section 2.1.1) there is mention of the Evergreen area and the zone of saline intrusion. No figures are referenced but Figure 3-3 does show the zone of saline intrusion. Please consider referencing Figure 3-3 here and also showing the zone of saline intrusion on Figures 2-13 and 2-14. Also, is the Evergreen area shown on any figure? Is the source of elevated TDS and/or nitrate in that area discussed somewhere?*

    <u>Response:</u> The District adjusted Figure 3-3 to show the location of the Evergreen area and to indicate the zone of saline intrusion. The source of elevated TDS is described in Section 3.4.1.

15. *Figure 3-3 shows 4 wells in the zone of saline intrusion. Are there additional monitoring wells in this area?*

    <u>Response</u>: There are 15 monitoring wells shown on Figure 4-1 that are used to measure changes in groundwater salinity near the bay. Four of these wells have consistently measured > 100 mg/L chloride.

16. *Division of the Santa Clara Plain into shallow and principal aquifers is only mentioned as a footnote to table 2-2. Better discussion of this division is warranted, especially because Figure 2-2 does not seem to support it. Similarly, the decision not to separate Coyote Valley into shallow and principal aquifers should be addressed. (e.g. no major aquitard etc.)*

    <u>Response:</u> Figure 2-2 was revised to make the shallow/principal designation more clear, and language was added language to Section 2.1.1 to explain this designation. For the Coyote Valley, text was edited to explain why it is treated as a single, unconfined aquifer.

17. *On page 23, I believe the figure being referenced should be 2-5. If so, I don't really see the correlation between the statement that high production wells are in the southern portion of Coyote Valley in that figure. Maybe it's a drafting issue?*

    Response: Yes, it was a drafting issue. Pumping in the Llagas Subbasin was shown, which obscured production wells at the southern end of Coyote Valley. Figure 2-5 was revised to show only Santa Clara Plain and Coyote Valley pumping.

18. *There is a lack of information regarding the modeling software used. What is the "District groundwater flow model" (p.27)? What are the SCPMOD and CVMOD models? (p.38). Are they MODFLOW with associated interfaces?*

    Response: A footnote was added to Section 2.1.5 with a brief explanation of the District's MODFLOW models.

19. *Both the TDS and Nitrate sections of Table 2-8 are identical. This would be quite a coincidence and may be a cut and paste error.*

    Response: This was a cut and paste error; the table has been corrected.

20. *The text in the Nitrate Trends section on page 31 does not match the associated table and does not appear to match Figures 2-13 and 2-14.*

    Response: The incorrect language was for the entire county, including the Llagas Subbasin. The wording and counts in the nitrate trends section have been updated, and the text was re-written so that the sections are now parallel. Note that in the PDF copy on the District website, the page number referenced is now 33.

21. *There are a number of tables listing values that do not align with the corresponding values shown in Table 3-20.*

    Response: The disparity between values in individual loading category tables and the summary table were primarily the result of rounding. Each table was checked and updated to confirm agreement with the underlying calculations and the summary table, which is numbered 3-19 in the PDF version on the District's website.

22. *Is basin inflow loading included with managed recharge? The numbers seem to indicate this but I'm not sure it's advisable.*

    Response: Basin inflow was inadvertently omitted from Table 3-20 (now Table 3-19 in the online PDF version). It has been added in and the percentages in Table 3-19 have been adjusted.

The District appreciates the Water Boards' participation in the development of the Santa Clara Subbasin SNMP as well as the detailed review of the Draft SNMP. If these responses require

any further resolution, please contact me at (408) 630-2051 or Vanessa De La Piedra at (408) 630-2788.

Sincerely,

Thomas Mohr, P.G., H.G.
Senior Hydrogeologist

cc: Alec Naugle, San Francisco Bay Water Board
Diane Barclay, State Water Board
V. De La Piedra, G. Hall

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Santa Clara Valley Water District

Sent via electronic mail, no hardcopy to follow

November 18, 2015

Ms. Dyan Whyte
Assistant Executive Officer
San Francisco Bay Regional Water Quality Control Board
1515 Clay Street, Suite 1400
Oakland, CA 94612

Subject: Response to San Francisco Bay Regional Water Quality Control Board Comments on Santa Clara Subbasin Salt and Nutrient Management Plan

Dear Ms. Whyte:

The Santa Clara Valley Water District (District) appreciates the San Francisco Bay Regional Water Quality Control Board's (Water Board) detailed supplemental review of the Santa Clara Subbasin Salt and Nutrient Management Plan (SNMP) and related comments dated September 1, 2015. We have conferred with Dr. Roberson and Mr. Naugle, and determined that the best format for responding to these comments will be as an SNMP Appendix that includes Water Board comments and District responses.

As requested in your September 1, 2015, letter, we are providing additional figures and explanations to delineate specific locations where Basin Plan Water Quality Objectives for salts and nutrients are exceeded. We are eager to finalize the Santa Clara Subbasin SNMP and will work with your staff to confirm these responses have fully addressed their comments. We are targeting District Board of Directors adoption of the SNMP in January 2016, after which we will seek a Water Board Resolution of Concurrence. If you have any questions regarding our responses, please call Mr. Thomas Mohr at (408) 630-2051, or me at (408) 630-2788.

Sincerely,

Van De La Piedra

Vanessa De La Piedra, P.E.
Groundwater Monitoring and Analysis Unit Manager

Attachments:
1. September 1, 2015, Comment Letter From the San Francisco Bay Regional Water Quality Control Board
2. Santa Clara Valley Water District Response to Comments

cc/att: Mr. Keith Roberson, San Francisco Bay Regional Water Quality Control Board
Mr. Alec Naugle, San Francisco Bay Regional Water Quality Control Board
T. Mohr, G. Hall, J. Fiedler

September 1, 2015

Sent via electronic mail: No hardcopy to follow

Santa Clara Valley Water District
5750 Almaden Expressway
San Jose, CA 95118-3686

Attn: Mr. Thomas Mohr
Email: tmohr@valleywater.org

Subject: **Comments on the Revised Salt and Nutrient Management Plan (SNMP) for the Santa Clara Subbasin, dated November 2014**

Dear Mr. Mohr:

The revised SNMP provides a solid foundation for guiding decision making, and we appreciate the District's efforts to address our comments on the initial July 2014 draft. In order for the Water Board to endorse the SNMP, we require additional information about the location and distribution of existing salt and nutrient concentrations in the Santa Clara Plain and Coyote Valley. While we recognize that our Basin Plan does not explicitly distinguish between the shallow and deep aquifers of the Santa Clara Plain, SNMPs must provide us with a better understanding of any localized areas (shallow and deep) where elevated salt and nutrient concentrations exist. This information is critical for the Water Board to effectively evaluate the need for source control measures in the context of waste discharge permitting related to salt and nutrient source discharges (e.g., OWTS and recycled water use). Just as we must understand the location of solvent and petroleum contaminants within shallow and deep aquifers, we must also understand the specific locations of salt and nutrient problems. Attached are additional suggestions for improving the SNMP and our remaining outstanding questions.

If you have any questions, please feel free to contact me (dwhyte@waterboards.ca.gov, 510-622-2441) or Keith Roberson (kroberson@waterboards.ca.gov 510-622-2404).

Sincerely,

Dyan Whyte
Assistant Executive Officer

SF Bay Regional Water Board staff questions and comments on the Revised Salt and Nutrient Management Plan (SNMP) for the Santa Clara Subbasin, dated November 2014

1. Executive Summary
   a. Consider including a brief summary of the District's role (or lack thereof) with managing fertilizer use and septic system regulation.
2. Introduction
   a. Section 1.1 – Consider including a brief summary of the current and projected recycled water use here. It's not until section 3.3.1.8 where the first quantification recycled water use is mentioned (6,6,40 AF), and that is the current use only. Table 3-23 indicates projected recycled water use by 2035 will be 26,500 AF.
   b. Section 1.2 - Consider including a brief summary of the District's plans for recharge/use of stormwater as per the State Board's Recycled Water Policy.
3. Chapter 2: Groundwater Subbasin Characterization
   a. The locations and spatial distribution of wells with elevated TDS and nitrate in the shallow and deep aquifers of the Santa Clara Plain and the Coyote Valley should be provided on figures (see comment s d and e below for further detail).
   b. While Figures 2-13 and 2-14 show the locations of wells with increasing TDS and nitrate trends, concentrations do not need to be increasing to pose a problem if they already exceed WQOs. The locations of wells where TDS and nitrate concentrations are currently elevated above WQOs should be provided (see comment s d and e below for further detail).
   c. Section 2.5.2 - The "Basin Plan agricultural objective" for nitrate + nitrite of 5 mg/L is not a water quality objective (WQO). Rather it is a threshold, and the objective is the "limit" value of 30 mg/L (see Table 3-6 in the Basin Plan). While this objective might be more appropriate to use as a basis for comparison, it would still be valuable for Water Board staff to know the locations of wells exceeding the agricultural guidelines (see comment s d and e below for further detail).
   d. Section 2.5.1 - Total Dissolved Solids – While we recognize that figures 3-7 and 3-8 do show the monitoring well locations used to estimate basin-wide average TDS and nitrate concentrations, respectively, for the Santa Clara Plain (shallow and deep) and the Coyote Valley, there are no figures that show the location-specific TDS or nitrate concentrations. Providing such figures would be very helpful to our evaluation of the SNMP and understanding the nature of localized areas of elevated TDS and nitrate that could affect our future source control/permitting efforts. Please consider providing figures that include:
      - All shallow aquifer wells in the SCP that exceed the TDS SMCL of 500 mg/L (as summarized in Table 2-2); include the zone of saline intrusion above 500 mg/L.
      - All 32 wells in the SCP principal (i.e., deep) aquifer that exceed the TDS SMCL of 500 mg/L ; the four (or is it five?) that are within the zone of saline

intrusion; the 27 that are outside it; and the distribution by shallow and deep (i.e., principal) aquifer.

- The two wells that exceed the TDS SMCL in the Coyote Valley.
- The location of any wells within the SCP or CV with upward trending TDS or TDS > SMCL that are intended to monitor the effects of recycled water use.

e. Section 2.5.2 – Nitrate – Same as 3d above, except regarding nitrate concentrations. Please consider providing figures that include:

- All shallow and deep aquifer wells in the SCP and CV that exceed the Basin Plan Water Quality Objectives *Threshold* and *Limit* values for Agricultural Supply of 5 mg/L and 30 mg/L, respectively, for nitrate + nitrite (see Table 3-6 in the Basin Plan), and the MCL of 45 mg/L, as summarized in section 2.5.2 and tables 2-2, 2-3, and 2-5.
- The location of any wells within the SCP or CV with upward trending nitrate, or nitrate > Ag or MCL objectives that are intended to monitor the effects of recycled water use.

4. Chapter 3: Salt and Nutrient Loading

   a. Section 3.4.1 – Ambient Groundwater Quality – This section describes two areas with naturally-occurring elevated TDS (i.e., Evergreen and Palo Alto). Are there similar localized elevated TDS areas of non-natural origin?

   b. Table 3-23 and figure 3-11a suggest that as recycled water use for landscape irrigation increases from about 7,000 AF today to 25,000 AF, so does the loading, in tons. That's about a 1-1 correlation (1 ton of salt loading per every 1,000 acre-feet of recycled water use). Is that meant to be a static assumption? Does it account for the addition of advanced-treated water with lower TDS? Also, what is the projected breakdown of tertiary vs. advanced-treated recycled water use for landscape irrigation over the 25 year planning period?

   c. Table 3-22 (and ES-2) clearly shows that the shallow aquifer in the Santa Clara Plain has no assimilative capacity (negative 28 mg/L TDS). Section 3.4.1 indicates that the zones of naturally-occurring elevated TDS (Evergreen and Palo Alto) were included in the estimate. Was the area of saline intrusion also included? Our concern is that for purposes of projecting assimilative capacity use over the next 25 years, the shallow and deep aquifers of the SCP are averaged together. This yields an apparent positive assimilative capacity of 75 mg/L TDS. We are interested to know what the shallow zone would look like if it did not include certain portions of the zone of saline intrusion and/or the naturally-occurring areas of elevated TDS.

5. Chapter 4: Salt and Nutrient Monitoring Plan

   a. This chapter concludes that the District's existing groundwater monitoring program adequately accomplishes the monitoring necessary to assess salt and nutrient loading in the Santa Clara Plain and Coyote Valley basins. However, as noted in Chapter 2, there are localized areas where TDS and nitrate already exceed WQOs. Is the groundwater monitoring capability *in these particular areas* adequate to

provide the information necessary to assess threats to water quality and human health? Are there any places where additional wells would be beneficial?

6. Appendix 3: Groundwater Monitoring Plan

    a. Sections 2.4.1 and 2.4.2 indicate that the index well coverage for the SCP and CV is incomplete – the SCP shallow zone has 11 of 18 wells needed (61% coverage); the SCP deep zone has 20 of 35 wells needed (57% coverage); the CV has 8 of 11 wells needed (73% coverage). The specific well locations are shown in figures 2-2, 2-3, and 2-4 of Appendix 3. What is the plan and schedule to reach 100% monitoring coverage in these basins?

    b. Section 3.7.2 – South Bay Water Recycling Program – This section indicates that the SBWRP monitors six deep supply wells and six shallow monitoring wells in the vicinity of San Jose's recycled water use locations. Were the data from these monitoring wells included in the baseline groundwater quality evaluation for the shallow and deep aquifers of the SCP? The data from these wells should also be included with figures requested under 3d and 3e above. Any other wells specifically monitored in association with recycled water projects should be included

    c. Section 4.2 – Salt Water Intrusion Monitoring Network – The District's 22 shallow aquifer monitoring wells for salt water intrusion should be included in figures requested under 3d above.

SANTA CLARA VALLEY WATER DISTRICT RESPONSES TO THE SAN FRANCISCO BAY REGIONAL WATER QUALITY CONTROL BOARD'S SEPTEMBER 1, 2015, COMMENTS

Water Board Comment 1:

Executive Summary - Consider including a brief summary of the District's role (or lack thereof) with managing fertilizer use and septic system regulation.

SCVWD Response:

Since the 1990s, the District has implemented numerous programs and activities to address elevated nitrate. The District's nitrate management strategy is to implement programs and work with stakeholders, regulatory and land use agencies to: 1) define the extent and severity of nitrate contamination, 2) identify potential sources, 3) reduce nitrate loading to groundwater, and 4) reduce customer exposure to elevated nitrate. Recently, the District was the recipient of the Groundwater Resources Association of California's esteemed *Kevin J. Neese* award for its free nitrate testing program for domestic wells.

District efforts to address elevated nitrate include:

- Conducting ongoing monitoring and analysis of nitrate trends and hot spots,
- Recharging low-nitrate surface water through district recharge facilities to help dilute nitrate in groundwater,
- Initial pilot testing of approximately 600 South County domestic wells for nitrate in 1998,
- Providing in-field nutrient assistance for growers between 2002 and 2007,
- Conducting outreach through workshops and targeted materials including nitrate fact sheets and nutrient management guidelines for growers,
- Leading efforts to develop Salt and Nutrient Management Plans in collaboration with basin stakeholders (including the agricultural community) and the Regional Water Quality Control Boards,
- Working with the Resource Conservation Districts to provide irrigation efficiency and nutrient management resources to Santa Clara County growers,
- Working to influence state and/or local legislation and policies related to nitrate, including participation in efforts such as the Wastewater Advisory Group related to the Santa Clara County Onsite Wastewater Treatment System ordinance update,
- Offering basic water quality testing to eligible domestic well owners, with over 1,150 individual wells tested since 2011 http://www.valleywater.org/Services/FreeTestingProgram.aspx,
- Offering rebates for nitrate treatment systems for well users exposed to elevated nitrate beginning in fall 2013 as part of the Safe, Clean, Water and Natural Flood Protection Program approved by county voters http://www.valleywater.org/NitrateRebate/,
- Maintaining a Nitrate in Groundwater Web Page and comprehensive Private Well Owner's Guide.

District staff will continue to work in coordination with the Regional Water Quality Control Boards, agricultural community, and other basin stakeholders to address elevated nitrate in South County groundwater and wells.

Water Board Comment 2a:

Introduction Section 1.1 – Consider including a brief summary of the current and projected recycled water use here. It's not until section 3.3.1.8 where the first quantification recycled water use is mentioned (6,640 AF), and that is the current use only. Table 3-23 indicates projected recycled water use by 2035 will be 26,500 AF.

SCVWD Response:

An updated summary is provided below:

Current and Projected Recycled Water Use (updated October 2015)

The three wastewater treatment plants operating in the Santa Clara Plain currently produce tertiary treated recycled water for landscape irrigation and industrial uses. Advanced treated recycled water ("purified water") is also produced at the Silicon Valley Advanced Water Purification Center. Purified water is currently blended with tertiary treated recycled water from the South Bay Water Recycling system, which results in substantially lower TDS and nitrate concentrations for recycled water users.

In response to the District Board of Directors policy to "protect, maintain, and develop recycled water" the District's Chief Executive Officer has identified a goal of that at least 10% of the County's water demands be met with recycled water by 2025. In response to the continuing drought, the District is expediting potable reuse projects, including groundwater recharge projects using purified water in existing and new percolation ponds and injection wells. The preliminary target is to produce 45,000 acre-feet of purified water by 2020; however, the quantity and schedule are subject to change pending outcome of ongoing planning studies. The District is currently producing up to 8 million gallons per day of purified water, which has a salt content averaging 50 mg/L (as total dissolved solids).

A summary of the projected recycled water production for each facility located in the Santa Clara Plain is listed in Table A6-1 below.

Table A6-1
Current and Projected Recycled Water Production and Quality

System	Current Production and Quality	Future Production and Quality
South Bay Water Recycling (San Jose/Santa Clara)	10,200 AFY 500 mg/L TDS	25,000 AFY tertiary + adv. 500 mg/L TDS
Sunnyvale	1,700 AFY tertiary 760 to 1,100 mg/L TDS	3,100 AFY advanced 760 mg/L TDS
Palo Alto	1,500 AFY tertiary 770 mg/L TDS	7,000 AFY tertiary 600 mg/L TDS
Silicon Valley Advanced Water Purification Center	9,000 AFY 50 mg/L TDS currently blended with SBWR tertiary for irrigation and industrial uses	45,000 AFY 50 mg/L TDS to be used for indirect potable reuse or possible future direct potable reuse

Recycled Water Production Figures Updated October 2015; average values rounded to nearest 100 AFY. Note that all future projections are subject to change. The projected increase of 15,000 AFY for the South Bay Water Recycling System is included in the 45,000 AFY projected for the Silicon Valley Advanced Water Purification Center.

Water Board Comment 2b:

Introduction Section 1.2 - Consider including a brief summary of the District's plans for recharge/use of stormwater as per the State Board's Recycled Water Policy.

SCVWD Response:

The District's plans for recharge and use of stormwater are stated in Section 1.5.4 Goals and Objectives for Recycled Water and Stormwater. The District actively recharges stormwater, which is incorporated into managed aquifer recharge operations throughout the County. As a member of the Santa Clara Valley Urban Runoff Pollution Prevention Program, the District works with other co-permittees to maximize stormwater infiltration while protecting groundwater quality. Section A-4.1.2 in the SNMP provides a detailed description of this effort.

Water Board Comments 3a and 3b:

Chapter 2 - Groundwater Subbasin Characterization

a. The locations and spatial distribution of wells with elevated TDS and nitrate in the shallow and deep aquifers of the Santa Clara Plain and the Coyote Valley should be provided on figures (see comments d and e below for further detail).
b. While Figures 2-13 and 2-14 show the locations of wells with increasing TDS and nitrate trends, concentrations do not need to be increasing to pose a problem if they already exceed WQOs. The locations of wells where TDS and nitrate concentrations are currently elevated above WQOs should be provided (see comments d and e below for further detail).

SCVWD Response:

Figures A6-1, A6-2, and A6-3 have been added to the SNMP in this appendix to show the locations of wells in which Basin Plan Water Quality Objectives are exceeded.

Water Board Comment 3c:

Section 2.5.2 - The "Basin Plan agricultural objective" for nitrate + nitrite of 5 mg/L is not a water quality objective (WQO). Rather it is a threshold, and the objective is the "limit" value of 30 mg/L (see Table 3-6 in the Basin Plan). While this objective might be more appropriate to use as a basis for comparison, it would still be valuable for Water Board staff to know the locations of wells exceeding the agricultural guidelines (see comments d and e below for further detail).

SCVWD Response:

Thank you for the clarification. Because the distinction between "threshold" and "limit" in Table 3-6 of the Basin Plan was not clear, the SNMP compared local groundwater quality against the more conservative "threshold" values. Figures A6-4 and A6-5 show locations where the threshold for water quality in agricultural supply (Table 3-6 of the Basin Plan) was exceeded. The Basin Plan 30 mg/L limit was not exceeded in any shallow or principal zone wells.

Given the Water Board's clarification, the last paragraph of Section 2.5.2 is updated to read:

The Basin Plan Agricultural Objective of 30 mg/L for nitrate + nitrite (as N) was not exceeded in any shallow or principal zone wells in the Santa Clara Groundwater Subbasin. For the more conservative "threshold" of 5 mg/L, thirty seven of 210 wells (18%) in the principal aquifer zone of the Santa Clara Plain exceeded the threshold, as did 22 wells (56%) in the Coyote Valley.

Water Board Comment 3d:

Section 2.5.1 - Total Dissolved Solids

While we recognize that figures 3-7 and 3-8 do show the monitoring well locations used to estimate basin-wide average TDS and nitrate concentrations, respectively, for the Santa Clara Plain (shallow and deep) and the Coyote Valley, there are no figures that show the location-specific TDS or nitrate concentrations. Providing such figures would be very helpful to our evaluation of the SNMP and understanding the nature of localized areas of elevated TDS and nitrate that could affect our future source control/permitting efforts. Please consider providing figures that include:

- All shallow aquifer wells in the SCP that exceed the TDS SMCL of 500 mg/L (as summarized in Table 2-2); include the zone of saline intrusion above 500 mg/L.
- All 32 wells in the SCP principal (i.e., deep) aquifer that exceed the TDS SMCL of 500 mg/L; the four (or is it five?) that are within the zone of saline intrusion; the 27 that are outside it; and the distribution by shallow and deep (i.e., principal) aquifer.
- The two wells that exceed the TDS SMCL in the Coyote Valley.
- The location of any wells within the SCP or CV with upward trending TDS or TDS > SMCL that are intended to monitor the effects of recycled water use.

SCVWD Response:

Figures A6-1 and A6-2 have been added to the SNMP in this appendix to show the locations of wells in which Basin Plan Water Quality Objectives are exceeded. These figures include TDS SMCL exceedances in the zone of saline intrusion.

Figure A6-6 is added to the SNMP in this appendix to show the location of monitoring wells intended to monitor the effects of recycled water irrigation.

A separate City of San Jose monitoring program for recycled water irrigation has been conducted to evaluate trends in shallow groundwater during more than a decade of recycled water irrigation. The District incorporates the City's findings in the Annual Groundwater Report. For example, the general water quality findings related to groundwater monitoring at Santa Clara Plain recycled water irrigation sites per the District's 2013 Annual Groundwater Report are listed in Table A6-2, below:

Table A6-2
Summary of General Water Quality Findings for Santa Clara Plain Recycled Water Irrigation Monitoring Wells

Recycled Water Irrigation Groundwater Monitoring Site	General Water Quality Observations
IDT	• Basic chemical composition is stable compared to previous events. • Increasing trends continue to be observed at three of the four wells for salts (bromide, chloride, calcium, sodium, TDS) and dissolved oxygen.
SBWR	• The basic chemical composition for various wells indicates a shift towards more saline water, primarily due to increasing chloride at the Curtner, Kelley Park, Columbus Park, Watson Park, and Evergreen Park wells. • Increasing trends continue to be observed for salts (including chloride, boron, sodium, and sulfate) at the majority of SBWR monitoring wells.

The City of San Jose commissioned a report on the SBWR recycled water irrigation groundwater monitoring network in 2009. A plot of TDS trends from the City's 2009 analysis is included as Figure A6-7. Figure A6-8 had been added to the SNMP in this appendix to show the locations of recycled water irrigation monitoring wells within the Santa Clara Plain with upward trending TDS. There is no recycled water irrigation in the Coyote Valley and, as such, no related monitoring wells.

Water Board Comment 3e:

Section 2.5.2 – Nitrate

Same as 3d above, except regarding nitrate concentrations. Please consider providing figures that include:

- All shallow and deep aquifer wells in the SCP and CV that exceed the Basin Plan Water Quality Objectives Threshold and Limit values for Agricultural Supply of 5 mg/L and 30 mg/L, respectively, for nitrate + nitrite (see Table 3-6 in the Basin Plan), and the MCL of 45 mg/L, as summarized in section 2.5.2 and tables 2-2, 2-3, and 2-5.
- The location of any wells within the SCP or CV with upward trending nitrate, or nitrate > Ag or MCL objectives that are intended to monitor the effects of recycled water use.

SCVWD Response:

Figure A6-3 shows the locations of wells in which the MCL for nitrate is exceeded. Figures A6-4 and A6-5 show locations of wells in which the Ag Water Quality Threshold is exceeded. None of the monitored wells in the Santa Clara Subbasin exceed the Ag Water Quality Objective from Table 3-6 of the Basin Plan (30 mg/L nitrate + nitrite as N). The District's Annual Groundwater Reports summarize significant trends for monitored parameters at recycled water irrigation sites.

Figure A6-9 has been added to the SNMP in this appendix to show the locations of recycled water irrigation monitoring wells within the Santa Clara Plain with upward trending nitrate. Trend determination is based on District analysis (as reported in the Annual Groundwater Report) or the 2009 SBWR evaluation as noted on the figure. There is no recycled water irrigation in the Coyote Valley and, as such, no related monitoring wells.

Water Board Comment 4a:

Section 3.4.1 Ambient Groundwater Quality – This section describes two areas with naturally-occurring elevated TDS (i.e., Evergreen and Palo Alto). Are there similar localized elevated TDS areas of non-natural origin?

SCVWD Response:

The District monitors 58 shallow and principal zone wells in the Santa Clara Plain annually, and merges that data with municipal well data from the Division of Drinking Water database. The District is not aware of any spatial patterns that reflect localized elevated TDS of non-natural origin.

Water Board Comment 4b:

Table 3-23 and Figure 3-11a suggest that as recycled water use for landscape irrigation increases from about 7,000 AF today to 25,000 AF, so does the loading, in tons. That's about a 1-1 correlation (1 ton of salt loading per every 1,000 acre-feet of recycled water use). Is that meant to be a static assumption? Does it account for the addition of advanced-treated water with lower TDS? Also, what is the projected breakdown of tertiary vs. advanced-treated recycled water use for landscape irrigation over the 25 year planning period?

SCVWD Response:

Per Figure 3-11a, the salt loading from all recycled water use within the Santa Clara Plain is nearly 25,000 AF in 2035, which is essentially a 1:1 correlation (1 ton of salt loading per 1,000 AF of recycled water use) in that year. However, this is not a static assumption, as the projected loading for each year is assessed independently considering recycled water use and water quality. For example, since 2014, the District has been operating the Silicon Valley Advanced Water Purification Center (SVAWPC), which produces 8 million gallons per day of advanced-treated water with TDS less than 60 mg/L. Purified water is blended with SBWR tertiary treated recycled water to produce delivered water with TDS of about 500 mg/L. The SNMP analysis accounts for increased recycled water irrigation from SBWR, Sunnyvale, and Palo Alto, as well as water quality improvements over the 25 year planning period, which are summarized in Table 3-27.

At present, SBWR delivers a blend of tertiary treated and advanced-treated water with TDS of about 500 mg/L, while Palo Alto and Sunnyvale deliver recycled water with TDS ranging from 700 to 1,100 mg/L. The volumes and quality of recycled water used for irrigation in Palo Alto and Sunnyvale may change significantly within the SNMP planning horizon. Recently, the City of Palo Alto and the District formed a joint committee to explore opportunities to produce purified water to further lower the TDS of recycled water used for irrigation. The City of Sunnyvale is in the final stages of preparing an EIR for upgrades to their Water Pollution Control Plant, which may include advanced treatment. Sunnyvale anticipates producing lower TDS recycled water to irrigate more sites, including the new

Apple II campus in Cupertino. These improvements may produce substantial decreases in salt loading from the current practice of using tertiary treated recycled water for irrigation. As the expected water quality is not known with certainty, the SNMP conservatively assumes that the current tertiary treated water will continue to be used for irrigation.

Water Board Comment 4c:

Table 3-22 (and ES-2) clearly shows that the shallow aquifer in the Santa Clara Plain has no assimilative capacity (negative 28 mg/L TDS). Section 3.4.1 indicates that the zones of naturally-occurring elevated TDS (Evergreen and Palo Alto) were included in the estimate. Was the area of saline intrusion also included? Our concern is that for purposes of projecting assimilative capacity use over the next 25 years, the shallow and deep aquifers of the SCP are averaged together. This yields an apparent positive assimilative capacity of 75 mg/L TDS. We are interested to know what the shallow zone would look like if it did not include certain portions of the zone of saline intrusion and/or the naturally-occurring areas of elevated TDS.

SCVWD Response:

The area of saline intrusion as delineated by the extent of the 100 mg/L chloride contour was excluded from the calculation of shallow aquifer assimilative capacity, as indicated in SNMP section 2.5.1 on page 31. The locations of naturally occurring elevated TDS are within the principal aquifer, so they do not affect the determination of assimilative capacity in the shallow aquifer. Therefore, assimilative capacity in the shallow aquifer is expected to remain negative in the next 25 years. However, there are a few mitigating factors that could lead to improvements in shallow aquifer TDS:

- Since the District implemented its turf replacement rebate program, well over 4 million square feet of irrigated turf has been replaced with xeriscape or other low-water landscaping alternatives in 2015 alone, bringing the total turf replaced since the program began to nearly 7 million square feet. This program reduces outdoor irrigation, a primary source of salt loading and was not incorporated into the projected salt loading from outdoor irrigation.

- As described above, the District's Silicon Valley Advanced Water Purification Center is now producing 8 million gallons per day of purified water with TDS less than 60 mg/L. That water is blended with tertiary treated recycled water, to lower TDS from the 750 to 950 mg/L TDS range to approximately 500 TDS. These factors were included in the projected assimilative capacity calculation for the subbasin as a whole. New plans are in development to double the capacity of indirect potable reuse projects. The scale and volume of the planned program far exceeds the projections included in this SNMP. As the District's expedited indirect potable reuse program is still in development, the configuration and volume of projects is not finalized. The projections included in the SNMP also assumed a 50:50 blend of purified and local water. Current plans are to use 100% purified water for IPR, pending the outcome of geochemical compatibility studies. This would result in water with much lower TDS being recharged to groundwater than assumed in the SNMP. Percolating greater volumes of purified water is expected to significantly dilute shallow aquifer TDS in the long term.

- The cities of Mountain View and Palo Alto are working to resleeve sections of sewer trunk mains in which saline shallow groundwater is infiltrating. Completion of the first section of pipe near Shoreline Amphitheater resulted in an immediate and significant

decrease in the TDS of recycled water used for irrigation in Palo Alto. Planned continuation of this program will result in decreased salt loading.

Water Board Comment 5:

This chapter concludes that the District's existing groundwater monitoring program adequately accomplishes the monitoring necessary to assess salt and nutrient loading in the Santa Clara Plain and Coyote Valley basins. However, as noted in Chapter 2, there are localized areas where TDS and nitrate already exceed WQOs. Is the groundwater monitoring capability in these particular areas adequate to provide the information necessary to assess threats to water quality and human health? Are there any places where additional wells would be beneficial?

SCVWD Response:

The District's groundwater monitoring network provides extensive areal coverage of the Santa Clara Subbasin, which encompasses nearly 300 square miles. The District samples 70 wells each fall for many constituents, including nitrate and TDS. Through our voluntary domestic well testing program, the District tests nitrate at 200 to 300 domestic wells every year, including many in Coyote Valley, which is more prone to elevated nitrate due to agricultural fertilizers and septic tanks. In addition to this District monitoring, we evaluate water quality data (including nitrate and TDS) from hundreds of public water supply wells each year.

Although we believe the District's monitoring network is comprehensive and adequate to assess threats to water quality, we continually work to maintain and improve the monitoring network as needed. The District is in the process of updating the Groundwater Management Plan to satisfy the requirements of the Sustainable Groundwater Management Act. The findings of the SNMP and ongoing monitoring results may further shape the District's groundwater monitoring efforts. Findings from annual groundwater sampling, including updated long term trend analysis, are available in the District's Annual Groundwater Report[1]. The District believes that salt and nutrient monitoring data and analysis included in the Annual Groundwater Report satisfies the intent of the 2009 Recycled Water Policy.

Water Board Comment 6a:

Sections 2.4.1 and 2.4.2 indicate that the index well coverage for the SCP and CV is incomplete – the SCP shallow zone has 11 of 18 wells needed (61% coverage); the SCP deep zone has 20 of 35 wells needed (57% coverage); the CV has 8 of 11 wells needed (73% coverage). The specific well locations are shown in figures 2-2, 2-3, and 2-4 of Appendix 3. What is the plan and schedule to reach 100% monitoring coverage in these basins?

SCVWD Response:

In addition to the response to Comment 5, above, we note that the statistical analysis undertaken to identify the number of monitoring wells was meant to serve as a guideline for planning purposes. There are practical considerations that must be considered such as related costs to ratepayers, available land, and available funding. As compared to many other areas, the District conducts very extensive monitoring. Through our current network

[1] http://www.valleywater.org/Services/Groundwater.aspx

and ongoing modifications as conditions or needs change, we believe we are meeting our goal of obtaining adequate data to assess regional groundwater conditions.

Water Board Comment 6b:

Section 3.7.2 – South Bay Water Recycling Program – This section indicates that the SBWRP monitors six deep supply wells and six shallow monitoring wells in the vicinity of San Jose's recycled water use locations. Were the data from these monitoring wells included in the baseline groundwater quality evaluation for the shallow and deep aquifers of the SCP? The data from these wells should also be included with figures requested under 3d and 3e above. Any other wells specifically monitored in association with recycled water projects should be included.

SCVWD Response:

The data from the shallow South Bay Water Recycling (SBWR) recycled water irrigation monitoring wells was not included in the baseline groundwater quality evaluation for the shallow aquifers of the Santa Clara Plain. Wells used for deep monitoring were included as they are part of the Division of Drinking Water database. The data from the SBWR shallow monitoring wells is not ideally suited to merging with the District's regional monitoring because several of the wells had elevated nitrate or other constituents prior to initiation of recycled water irrigation. The District has not validated the SBWR data or incorporated it into its GIS and database; hence, it was excluded from the SNMP analysis. Figure A6-6 is provided to show the location of both the SBWR monitoring wells and the District's south San Jose recycled water irrigation monitoring wells (the "IDT" site). Data from the IDT wells was incorporated in the SNMP analysis.

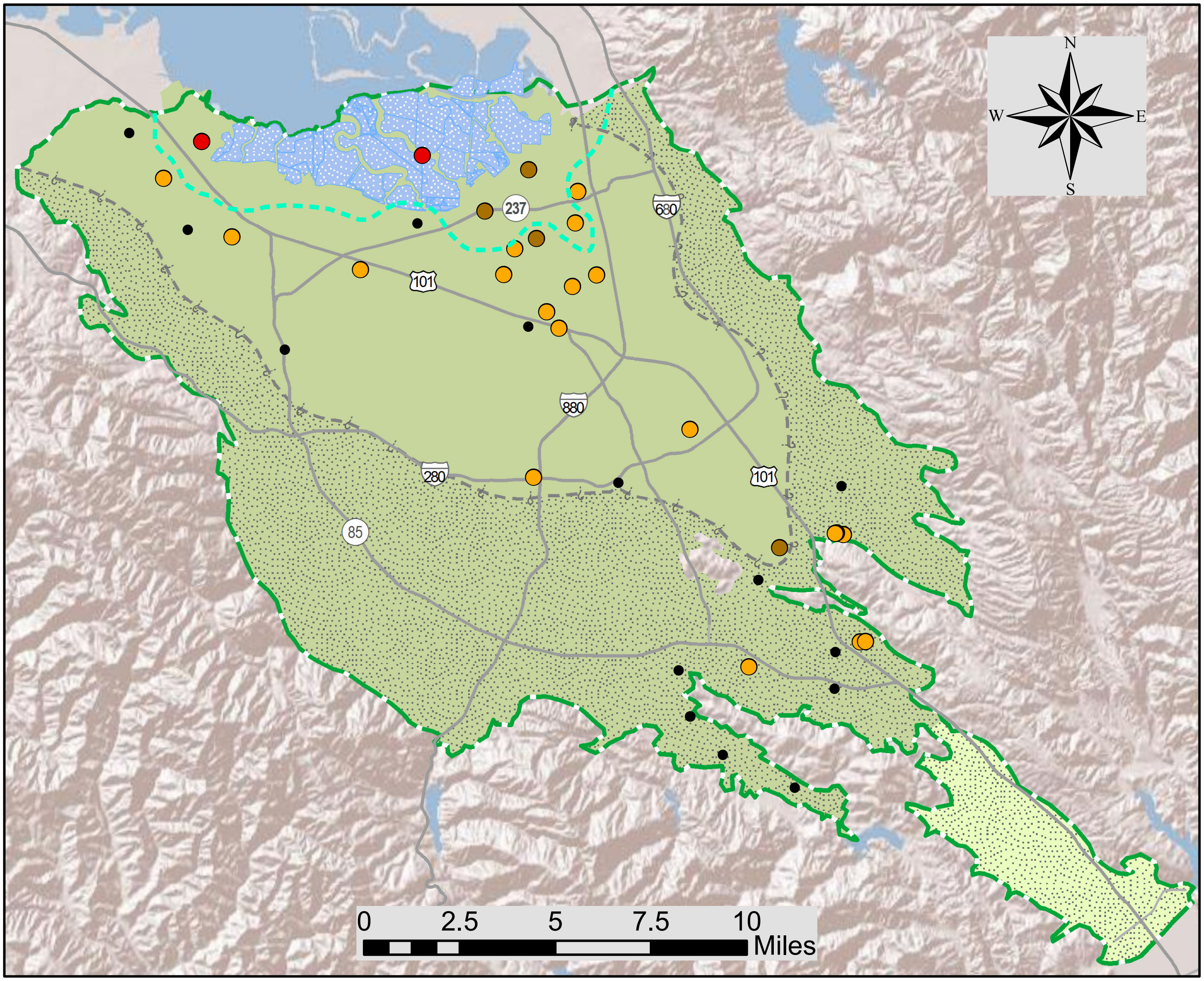
See responses to Comment 3d above to review the findings of the SBWR monitoring.

Water Board Comment 6c:

Section 4.2 – Salt Water Intrusion Monitoring Network – The District's 22 shallow aquifer monitoring wells for salt water intrusion should be included in figures requested under 3d above.

SCVWD Response:

The zone of saline intrusion is mapped in Figure 3-3 of the SNMP. This figure presents chloride concentration, which is conservatively indicative of saline intrusion where it exceeds 100 mg/L. New Figure A6-1, provided for this response to comments, includes the shallow monitoring wells currently used to monitor saline intrusion.



Legend

2012 100 mg/L Chloride Contour

TDS (mg/L) Shallow Zone

- < 500 (below SMCL)
- 500 - 1000
- 1000 - 1500
- 1500- 60000

Approximate Extent of Confined Area

Groundwater Subbasins

DWR Subbasins

Santa Clara (2-9.02)

District Groundwater Areas

Santa Clara Plain

Coyote Valley

Hydrographic Units

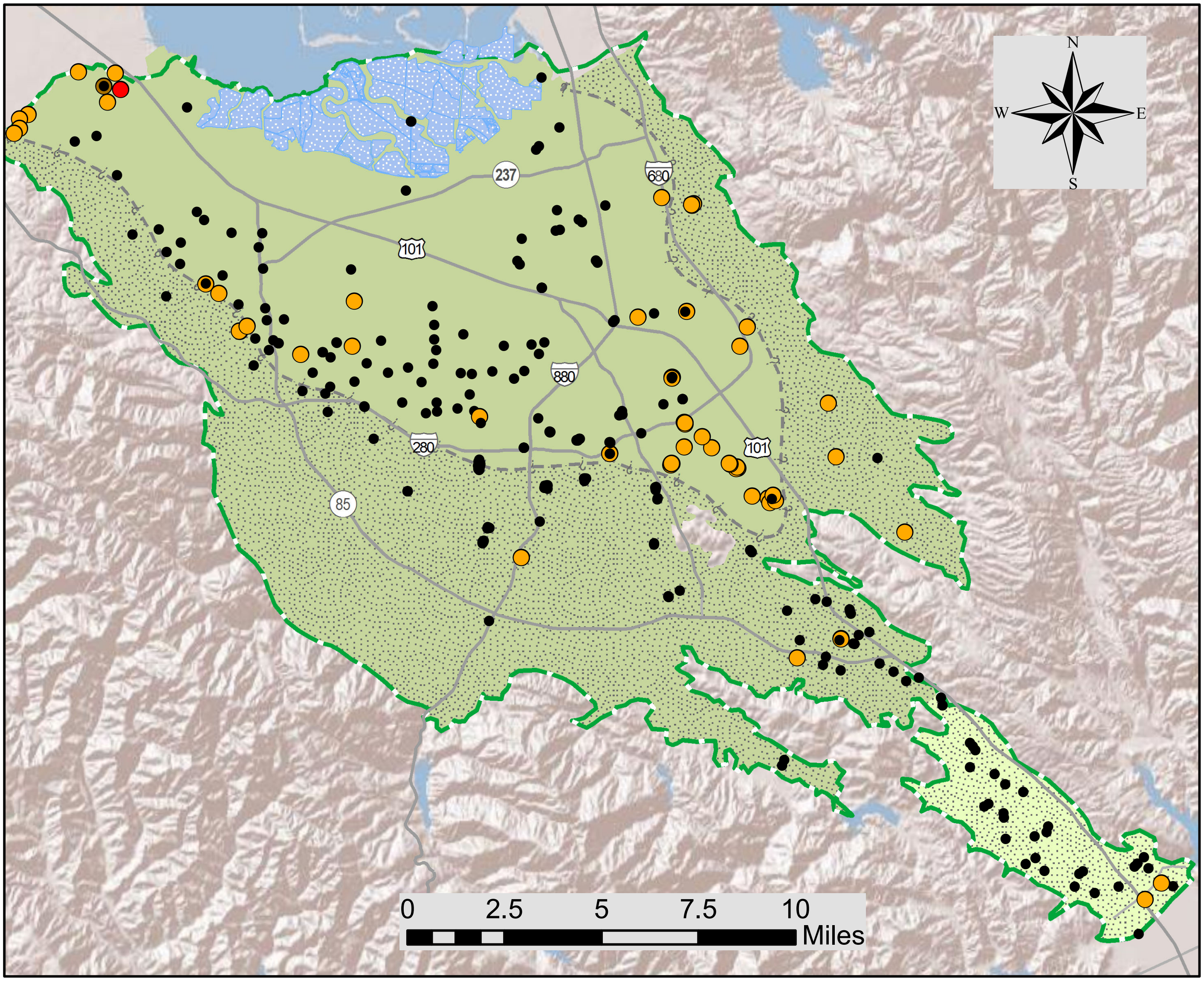
Santa Clara Plain Confined Area

Santa Clara Plain Recharge Area

Coyote Valley Recharge Area

Santa Clara Valley Water District

Figure A6-1 Shallow Aquifer Wells with TDS above SMCL Water Quality Objective (2000 - 2012 Median)



Legend

TDS (mg/L) Principal Zone

- < 500 (below SMCL)
- 500 - 1000
- 1000 - 1500
- 1500 - 6000
- Approximate Extent of Confined Area

Groundwater Subbasins

DWR Subbasins

Santa Clara (2-9.02)

District Groundwater Areas

Santa Clara Plain

Coyote Valley

Hydrographic Units

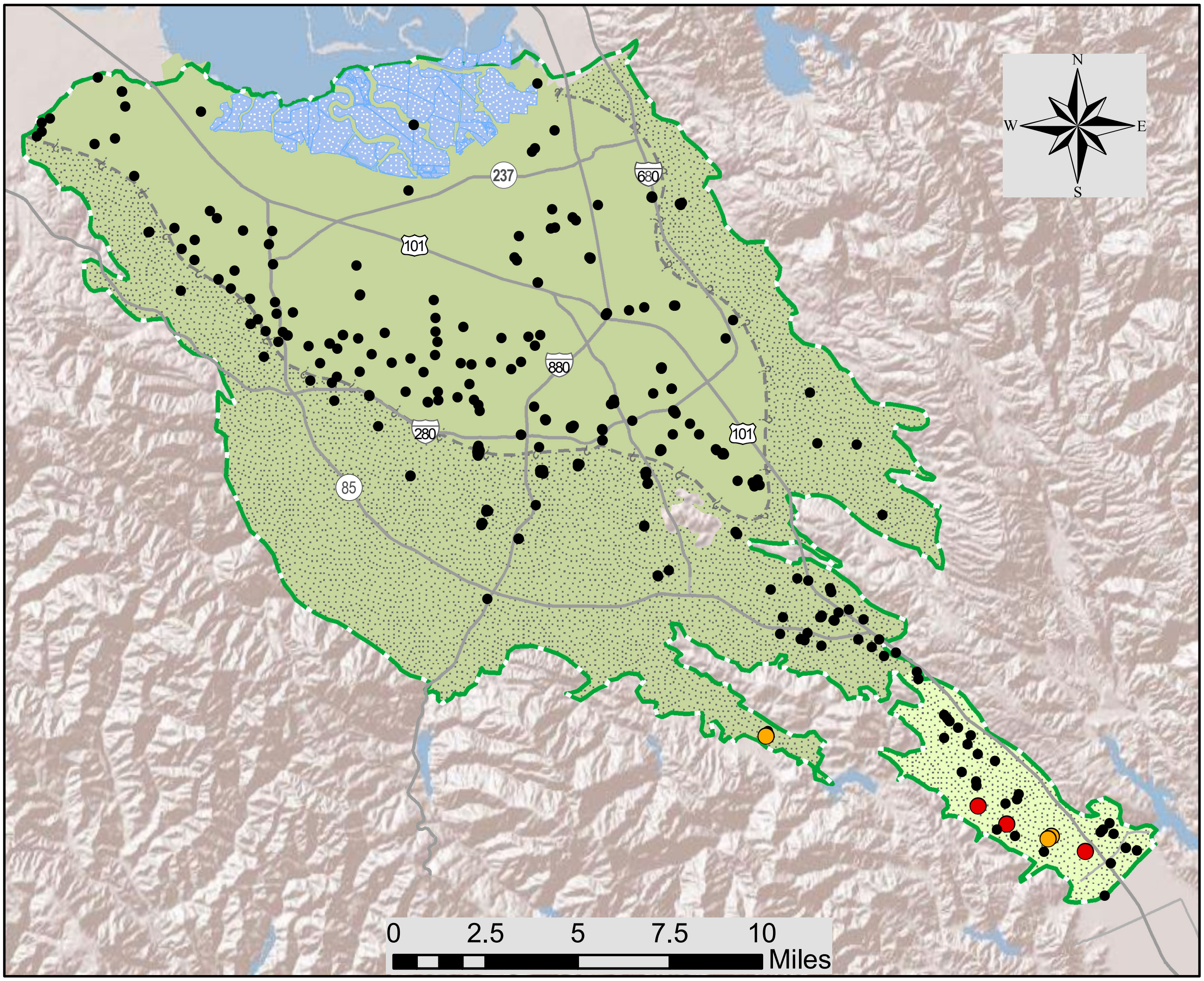
Santa Clara Plain Confined Area

Santa Clara Plain Recharge Area

Coyote Valley Recharge Area

Santa Clara Valley Water District

Figure A6-2 Principal Aquifer Wells with TDS above SMCL Water Quality Objective (2000 - 2012 Median)



Legend

Nitrate as NO3 (mg/L) Principal Zone

- < 45 (below MCL)
- 45 - 58
- 58 - 70
- Approximate Extent of Confined Area

Groundwater Subbasins

DWR Subbasins

- Santa Clara (2-9.02)

District Groundwater Areas

- Santa Clara Plain

- Coyote Valley

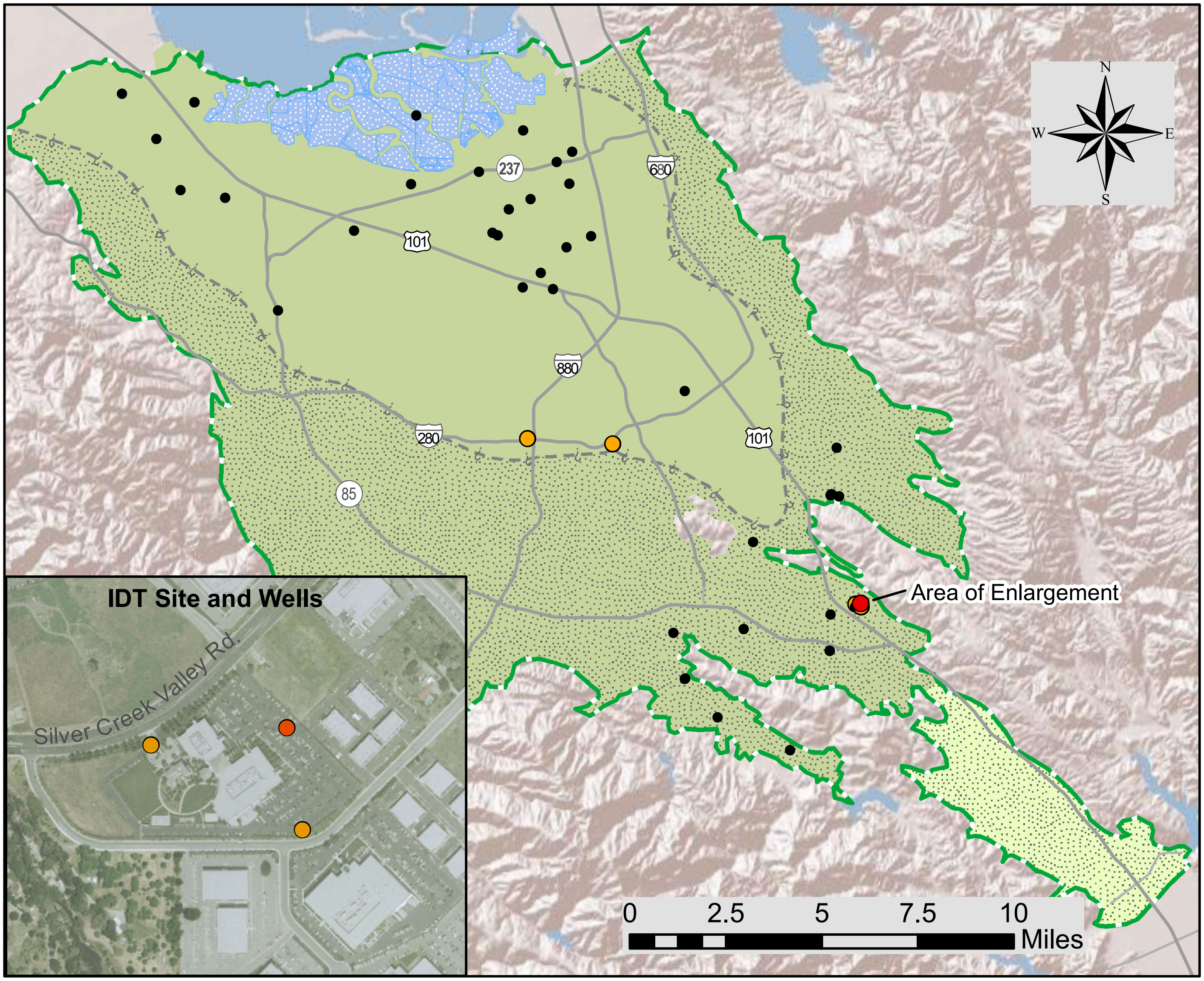
Hydrographic Units

- Santa Clara Plain Confined Area
- Santa Clara Plain Recharge Area
- Coyote Valley Recharge Area

Note:
Shallow Aquifer Wells had no Nitrate above MCL Water Quality Objective between 2000 and 2012

Santa Clara Valley Water District

Figure A6-3 Principal Aquifer Wells with Nitrate above MCL Water Quality Objective (2000 - 2012 Median)



Legend

Nitrate (mg/L) as N

- < 5 (below Ag Threshold)
- 5 - 7.5
- 7.5 - 10
- Approximate Extent of Confined Area

Groundwater Subbasins

DWR Subbasins

- Santa Clara (2-9.02)

District Groundwater Areas

- Santa Clara Plain

- Coyote Valley

Hydrographic Units

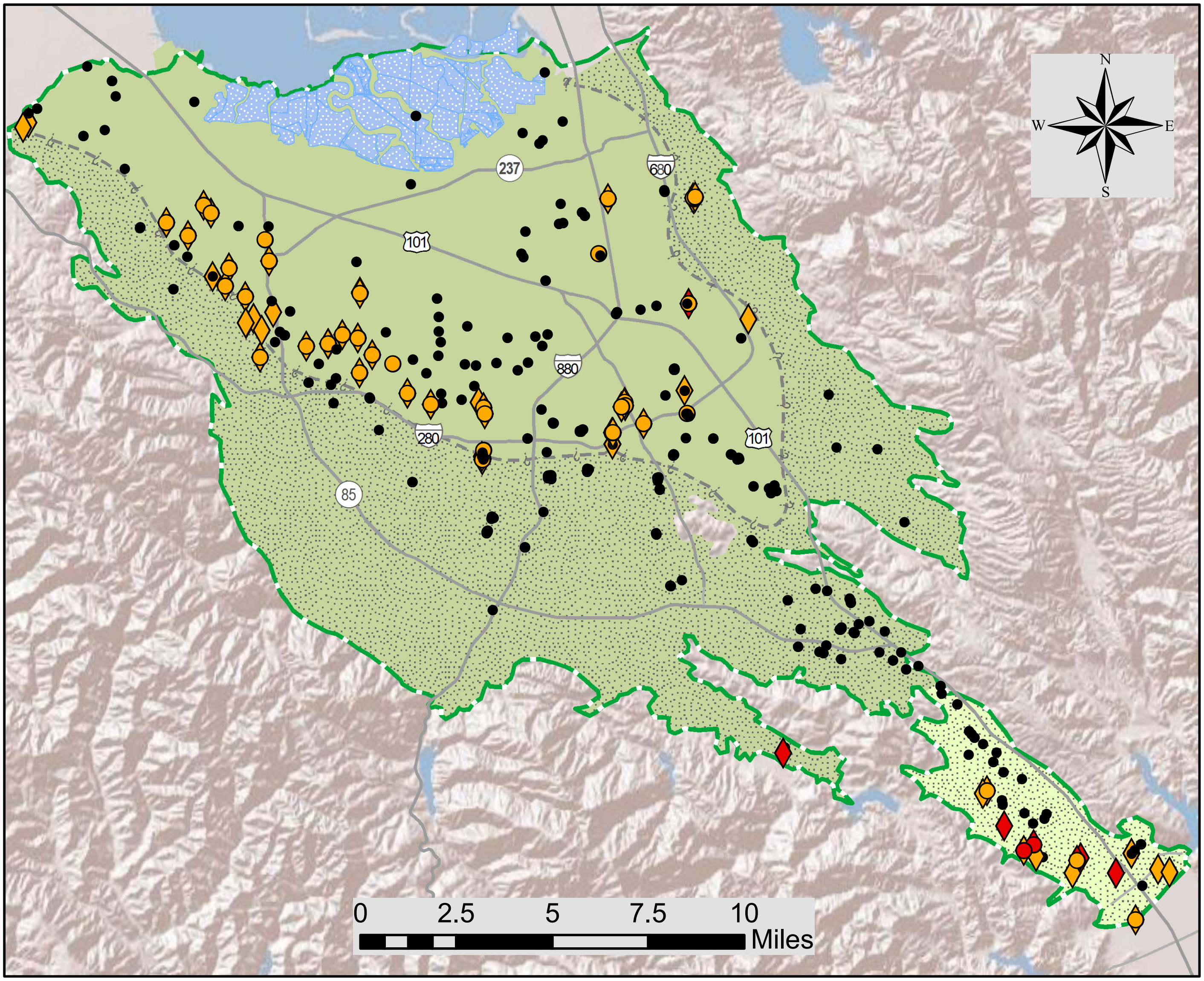
- Santa Clara Plain Confined Area
- Santa Clara Plain Recharge Area
- Coyote Valley Recharge Area

Santa Clara Valley Water District

Notes:

1. No wells exceeded the 30 mg/L Basin Plan Water Quality Objective.
2. Because nitrate as N is above 5 mg/L, nitrate + nitrite is assumed to be above 5 mg/L.

Figure A6-4 Shallow Aquifer Wells Exceeding Basin Plan Agricultural Water Quality Threshold for Nitrate + Nitrite as N (2000 - 2012 Median)



Legend

Nitrate as N

- < 5 (below Ag Threshold)
- 5 - 10
- 10 - 20

Nitrate + Nitrite as N

- <5 (below Ag Threshold)
- 5 - 10
- 10 - 15

Approximate Extent of Confined Area

Groundwater Subbasins

DWR Subbasins

Santa Clara (2-9.02)

District Groundwater Areas

Santa Clara Plain

Coyote Valley

Hydrographic Units

Santa Clara Plain Confined Area

Santa Clara Plain Recharge Area

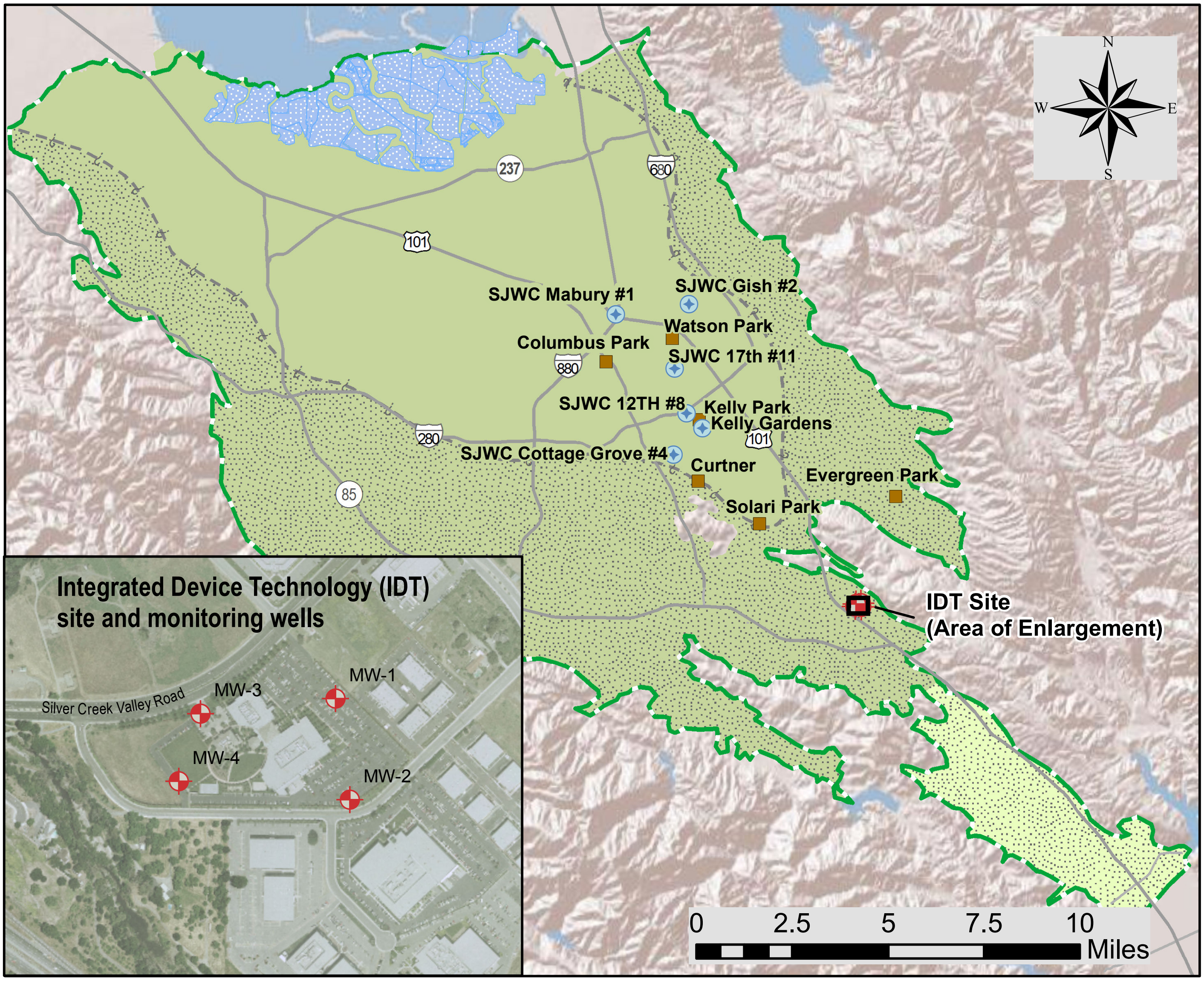
Coyote Valley Recharge Area

Santa Clara Valley Water District

Notes:

1. No wells exceeded the 30 mg/L threshold Basin Plan Water Quality Objective.
2. Analyses reported as nitrate + nitrite as N, or nitrate (as N or NO3)
3. Because nitrate as N is above 5 mg/L, nitrate + nitrite is assumed to be above 5 mg/L.

Figure A6-5 Principal Aquifer Wells Excceding Basin Plan Agricultural Water Quality Threshold for Nitrate + Nitrite (2000 - 2012 Median)



Legend

IDT Monitoring Wells

SBWR Monitoring Wells

Shallow Zone

Principal Zone

Approximate Extent of Confined Area

Groundwater Subbasins

DWR Subbasins

Santa Clara (2-9.02)

District Groundwater Areas

Santa Clara Plain

Coyote Valley

Hydrographic Units

Santa Clara Plain Confined Area

Santa Clara Plain Recharge Area

Coyote Valley Recharge Area

Santa Clara Valley Water District

Figure A6-6 Location of Wells Used to Monitor Recycled Water Irrigation

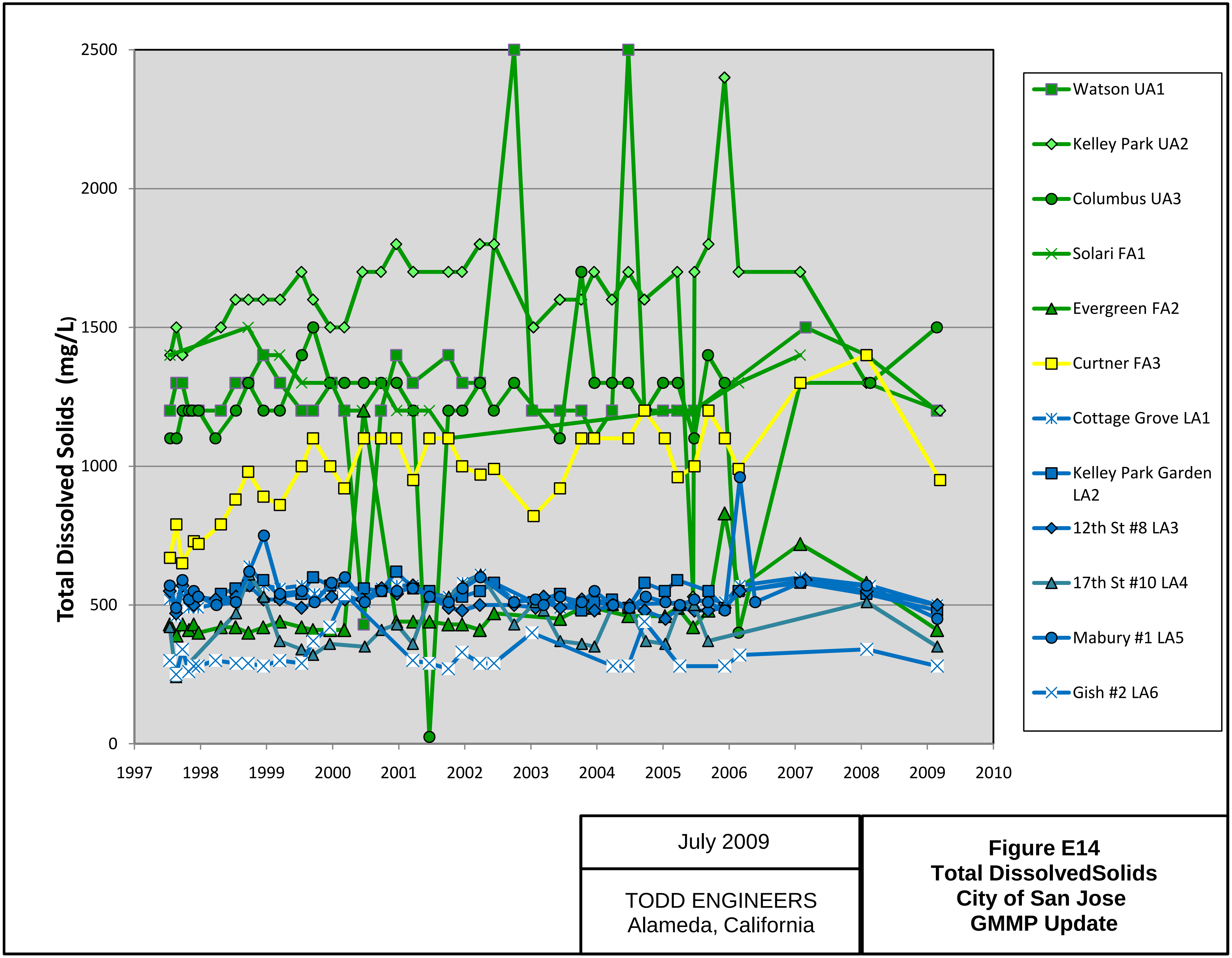
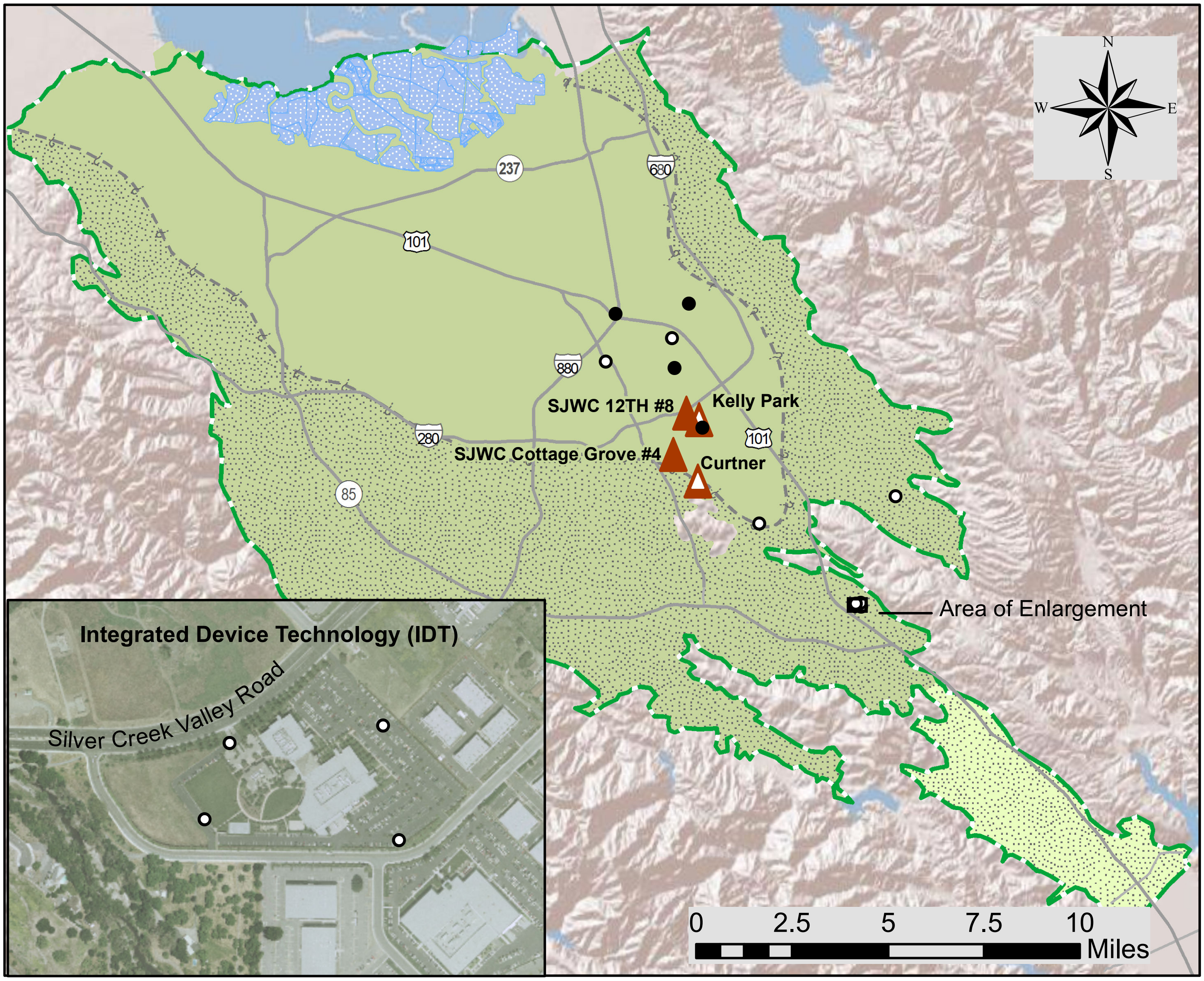


Figure A6-7 TDS Concentrations in SBWR Recycled Water Irrigation Monitoring Wells

Source: SBWR Technical Memorandum No. 2 Groundwater Monitoring and Mitigation Program Update Project, November 2009



Legend

Principal Zone Nitrate Trends

No Trend

Upwards Trend

Shallow Zone Nitrate Trends

No Trend

Upwards Trend

Approximate Extent of Confined Area

Groundwater Subbasins

DWR Subbasins

Santa Clara (2-9.02)

District Groundwater Areas

Santa Clara Plain

Coyote Valley

Hydrographic Units

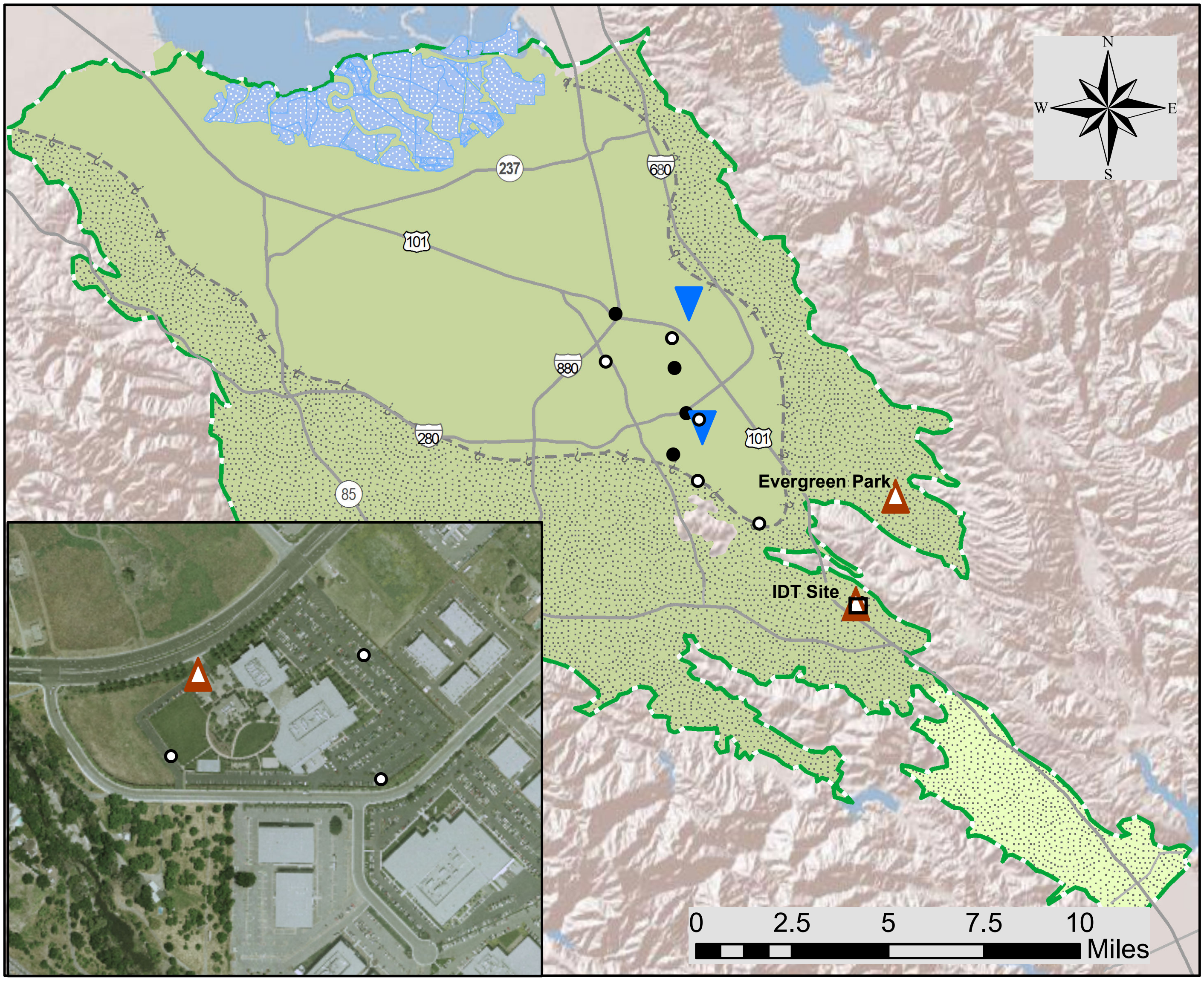
Santa Clara Plain Confined Area

Santa Clara Plain Recharge Area

Coyote Valley Recharge Area

Santa Clara Valley Water District

Figure A6-8 Post-Irrigation Nitrate Trends in Recycled Water Monitoring Wells



Legend

Shallow Zone TDS Trends

TDS_Trend

Upward Trend

No Trend

Principal Zone TDS Trends

Downward Trend

No Trend

Approximate Extent of Confined Area

Note: no principal zone recycled water irrigation monitoring wells have increasing TDS trends

Groundwater Subbasins

DWR Subbasins

Santa Clara (2-9.02)

District Groundwater Areas

Santa Clara Plain

Coyote Valley

Hydrographic Units

Santa Clara Plain Confined Area

Santa Clara Plain Recharge Area

Coyote Valley Recharge Area

Santa Clara Valley Water District

Figure A6-9 Post-Irrigation TDS Trends in Recycled Water Irrigation Monitoring Wells

5750 Almaden Expressway, San Jose, CA 95118-3614 | (408) 265-2600 | www.valleywater.org

Santa Clara Valley Water District

April 21, 2016

Mr. Alec Naugle
Senior Engineering Geologist
San Francisco Bay Regional Water Quality Control Board
1515 Clay Street, Suite 1400
Oakland, CA 94612

Subject: Response to San Francisco Bay Regional Water Quality Control Board Additional Comments on Santa Clara Subbasin Salt and Nutrient Management Plan

Dear Mr. Naugle:

The Santa Clara Valley Water District (District) has reviewed the San Francisco Bay Regional Water Quality Control Board's (Water Board) additional comments on the Santa Clara Subbasin Salt and Nutrient Management Plan (SNMP) transmitted on February 3, 2016, by e-mail. Please see our attached responses to Water Board comments, which we will append to the previously submitted SNMP Appendix that includes Water Board comments and District responses.

We are eager to finalize the Santa Clara Subbasin SNMP and will work with you to confirm these responses have fully addressed the Water Board's comments. We are targeting District Board of Directors adoption of the SNMP in June 2016, after which we will seek a Water Board Resolution of Concurrence. If you have any questions regarding our responses, please call Mr. Thomas Mohr at (408) 630-2051, or me at (408) 630-2788.

Sincerely,

Vanessa De La Piedra

Vanessa De La Piedra, P.E.
Groundwater Monitoring and Analysis Unit Manager

Attachment:
1. Santa Clara Valley Water District Response to February 3, 2016 E-mail Comments from San Francisco Bay Regional Water Quality Control Board

cc/att: Mr. Keith Roberson, San Francisco Bay Regional Water Quality Control Board
Mr. Nathan King, San Francisco Bay Regional Water Quality Control Board
Ms. Katrina Kaiser, San Francisco Bay Regional Water Quality Control Board
T. Mohr, G. Hall

SANTA CLARA VALLEY WATER DISTRICT RESPONSES TO THE SAN FRANCISCO BAY REGIONAL WATER QUALITY CONTROL BOARD'S FEBRUARY 3rd 2016 COMMENTS ON SANTA CLARA SUBBASIN SALT AND NUTRIENT MANAGEMENT PLAN

Water Board Comment 1:

The District's annual groundwater report for 2013 indicates that many domestic wells in the Coyote Valley are affected by nitrate and highlights differences between the District's regional monitoring program wells and purely domestic wells in the south county, which includes the Coyote Valley and Llagas sub-basin. Specifically, the regional wells have a median nitrate concentration of 17.6 mg/L, while 286 domestic wells tested throughout the south county have a median of 33.1 mg/L, and 34% of them exceed the MCL (45 mg/L). At the same time, the SNMP (Figure 3-19) indicates that about 75% of the total nitrate loading in the Coyote Valley is due to irrigated agriculture and fertilizer use, while about 15% is due to septic systems and other drainage losses.

SCVWD Response:

The apparent disparity noted between nitrate concentrations in the regional monitoring program wells and domestic wells is an artifact of the well groupings used in various tables in the District's 2013 Annual Groundwater Report. Table 9 lists the median nitrate concentration for "Zone W-5, South County" as 33.1 mg/L; however, Zone W-5 is a water revenue charge zone that includes both Coyote Valley and the Llagas Subbasin.

It is more informative to compare the regional monitoring wells used to obtain the 17.6 mg/L median in Table 7 of the 2013 Annual Report and the 2013 median of domestic wells located only within the Coyote Valley. With regard to nitrate results in the Coyote Valley for calendar year 2013, the District database includes data from 9 monitoring wells, 24 wells sampled by public water systems, and 35 domestic wells sampled under the District's domestic well testing program. The median nitrate concentration for all 68 wells was 23 mg/L, while the median of domestic wells was 21.1 mg/L. If domestic wells are excluded, the median was 25.8 mg/L.

When results for only Coyote Valley are considered, the median nitrate concentration from the District's regional monitoring program wells and domestic wells are in reasonable agreement. The Llagas Subbasin is addressed in a separate SNMP that was submitted to and accepted by the Central Coast RWQCB[1].

While we hope this clarifies the Water Board's specific question regarding 2013 data, the broader thrust of the question is to understand the overall occurrence of nitrate when considering all data. Because the number of wells tested varies by year, there is value in examining data from all wells for all years. Attachment 1 provides summary statistics, maps, and charts of nitrate test results for the Coyote Valley. Important limitations to the data are noted.

[1] The Llagas Subbasin SNMP is available on the District's website: http://www.valleywater.org/GroundwaterStudies/

Water Board Comment 2:

We would like to discuss with the District the details of an implementation plan to address this situation.

District Response:
The District engages in many groundwater quality management activities that are similar to the type of measures included in an implementation plan. A summary of these past and ongoing activities is provided in Appendix 4 to the SNMP. Our understanding is that implementation plans are necessary when the SNMP finds that assimilative capacity is either not available or will be exhausted within the 25-year SNMP planning horizon. The Santa Clara Subbasin SNMP finds that assimilative capacity is still available in 2035.

We believe that the District's ongoing groundwater quality management activities are proactive and effective, within the limits of the District's jurisdiction. Because the District is not a land use agency, we do not have authority over land uses that have the potential to increase nitrate loading.

As regards Coyote Valley, SNMP projections forecast that average nitrate concentrations will decrease substantially in the 25-year period ending in 2035, because nitrate loading is projected to decrease. Substantial groundwater pumping by Great Oaks Water Company for distribution in the Santa Clara Plain is a key factor that causes nitrate and salt to be removed from Coyote Valley. As groundwater is exported from Coyote Valley, significant quantities of nitrate and other salts are removed as well.

While the District's interpretation of the Recycled Water Policy does not include the need for preparing an implementation plan, the District would like to collaborate with RWQCB on groundwater protection activities in Coyote Valley. As discussed in our April 20th conference call, the District will begin sharing private well nitrate testing data with the Water Board beginning in early May 2016.

Water Board Comment 3:

Is there any effort to better identify the agricultural sources and locations?

SCVWD Response:
The District has conducted surveys of nitrate sources and nitrate occurrence in groundwater in the past. Most of these efforts have focused primarily on the Llagas Subbasin, while one has also included Coyote Valley. The findings of nitrate studies conducted by the District, Brown and Caldwell, and Lawrence Livermore Laboratories in the Llagas Subbasin are largely transferrable. The District's conceptual model ascribes the majority of nitrate found in groundwater to known non-point sources, including crop and lawn fertilizers and septic tanks[2]. Possible exceptions may include historic or current composting or food processing operations, and poultry or dairy operations. A list of relevant nitrate occurrence studies is provided below.

[2] On a local scale, septic tanks are point sources; on the basin scale, the wide distribution of numerous septic tanks (about 600 in Coyote Valley) manifests as an areal source.

- Brown and Caldwell, 1981. San Martin Area Water Quality Study: Prepared for the County of Santa Clara
- Santa Clara County Health Department, 1988. Santa Clara County Private Well Sampling Program-Final Report
- SCVWD, 1994. Llagas Groundwater Basin Nitrate Study Sample Point Selection Report, 25 p.
- SVCWD, 1993. Llagas Groundwater Basin Nitrate Study Nitrate Data Review, 42 p.
- SCVWD, 1992 (revised 1993). Quality Assurance Project Plan for Laboratory Contract to Provide Services for the Llagas Groundwater Basin Nitrate Study, 29 p.
- SCVWD, 1994. Santa Clara Valley Water District Llagas Groundwater Basin Nitrate Study Nitrate Source Area Identification, December, 1994, 56 p. (Section 205G) grant funds under Assistance Agreement C6009585-91-1 to the State Water Resources Control Board and by Contract No. 1-053-250-0, US EPA).
- SCVWD, 1996. Santa Clara Valley Water District Llagas Groundwater Basin Nitrate Study Final Report. October, 1996, 105 p.
- SCVWD, 1998. Private Well Water Testing Program Nitrate Data Report [Llagas Subbasin and Coyote Valley]. December, 1998.
- LLNL and SWRCB, 2005. California GAMA Program: Sources and transport of nitrate in shallow groundwater in the Llagas Basin of Santa Clara County, California. (UCRL-TR-213705).
- Carle, S., Esser, B., Moran, J., 2005. High-Resolution Simulation of Basin Scale Nitrate Transport Considering Aquifer System Heterogeneity. Geosphere (UCRL-JRNL-214721).

The Water Board expressed interest in understanding cropping patterns and fertilizer loading in Coyote Valley. We are providing 2015 cropping patterns in the Coyote Valley for your reference (see Attachment 1). It should be noted that cropping patterns frequently change from year to year, and multiple crops may be grown on the same field within a calendar year.

Water Board Comment 4:
How is the nitrate loading scenario for agriculture and onsite wastewater treatment systems (OWTS/septic systems) projected to change over time as land use changes?

SCVWD Response:
Per Table 3-23, agricultural fertilizer use was held constant through 2035 for the Santa Clara Subbasin SNMP, including Coyote Valley. Septic leach field volumes are assumed to remain constant. The County's new Onsite Wastewater Treatment System (OWTS) Ordinance could lead to some improvements in septic tank management, potentially decreasing loading from this source. The impacts of the ordinance are subject to many variables, so a constant value was used. These assumptions should conservatively estimate future nitrate loading from these sources.

Water Board Comment 5:
Are there nitrate hotspot areas where there is no access to delivered water or alternative supplies?

SCVWD Response:
The Coyote Valley domestic wells in which nitrate has been detected above the MCL are located in an elongated area extending nearly five miles from the southern border of Coyote Valley, i.e., an area encompassing about 2 square miles that covers more than half the length of Coyote Valley. However, about two-thirds of the wells in the area where most MCL exceedances occur have median nitrate concentrations below the MCL. While the definition of a "hot spot" is subjective, elevated nitrate appears to be more common in the southwest portion of the Coyote Valley. That area is not currently served by a major public water system; however, there are several small mutual water companies that serve groundwater. The District is currently offering rebates for well

users exposed to nitrate above the MCL. This program offers rebates of up to $500 for the installation of treatment units certified for nitrate removal. Rebate program information is sent to thousands of domestic well owners annually. Well owners participating in the District's domestic well testing program receive test results by mail and those with elevated nitrate are given a fact sheet and application for the rebate program. Although it has been in place for several years, the rebate program has had low participation. Most well owners contacted by the District are not participating in the rebate program because they drink bottled water or they have already installed treatment units. The District continues to look for opportunities to expand participation.

We are not aware of any plans to extend service connections from nearby municipal water systems or private water utilities to the unincorporated areas in Coyote Valley.

Water Board Comment 6:

Does the District have any plans to further investigate the nature/extent of the nitrate sources and their longevity?

SCVWD Response:

While we manage the groundwater subbasin, our jurisdictional mandate does not extend to water quality issues arising from land use. We assess current conditions and trends in nitrate, an effort supported by our free domestic well testing program. As described above, we are also working to reduce well owner exposure to nitrate by offering rebates for point of use treatment systems.

In the Llagas Subbasin, which extends from Cochrane Road near Morgan Hill south to the Pajaro River, we are working with the Central Coast Water Board to share information on patterns and trends in nitrate occurrence; however, that work does not extend to identifying sources. The District supports a similar exchange of data and information with the San Francisco Bay Water Board if it is of interest to the Water Board.

ATTACHMENT 1 – NITRATE OCCURRENCE IN COYOTE VALLEY

Nitrate groundwater quality data from wells in the Coyote Valley is available from one well as early as 1949, and in multiple wells from the 1980s and later. Figure 1 provides a summary of past nitrate testing in Coyote Valley wells. Figure 1 includes samples from municipal wells and agricultural wells, but the great majority of wells shown are domestic wells.

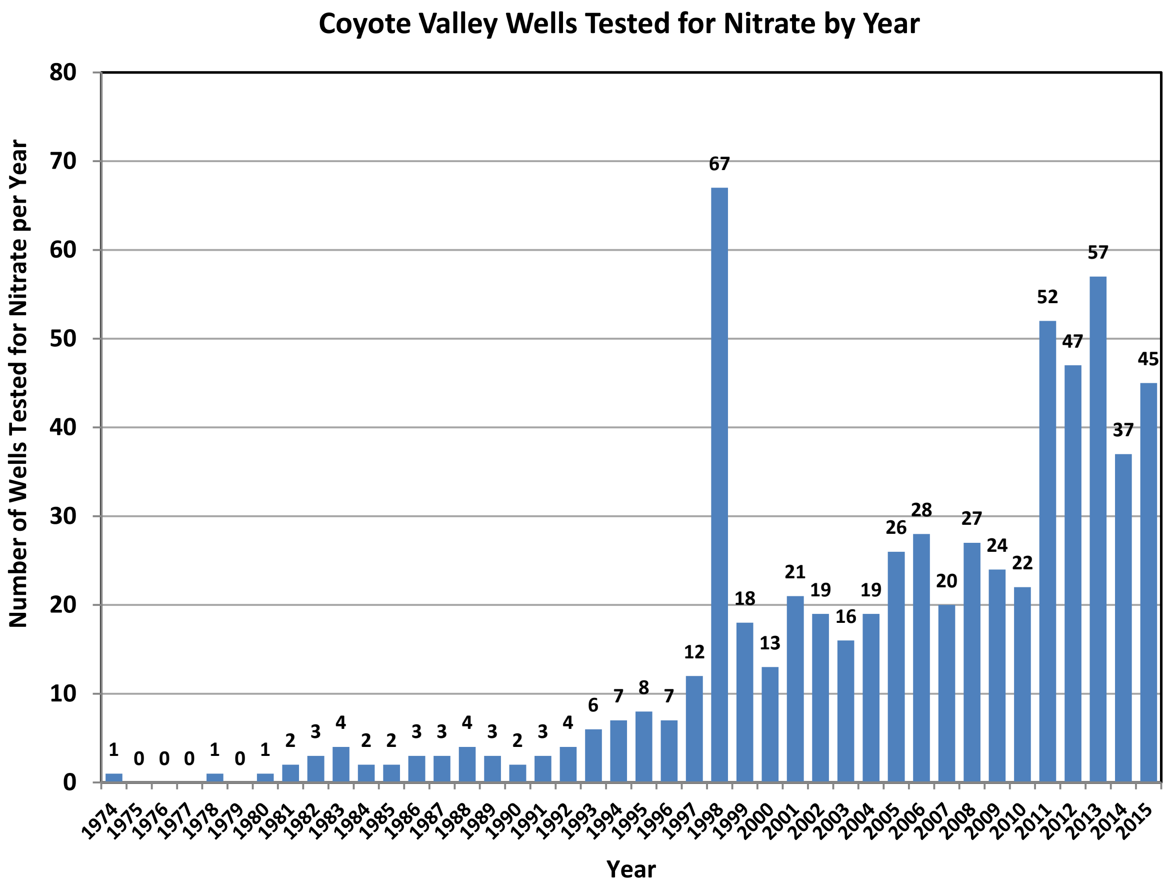


Figure 1 – Number of Coyote Valley Wells Tested for Nitrate per Year

Nitrate concentrations are elevated in some wells in the southwestern portion of Coyote Valley. A summary of nitrate detections with respect to the MCL is provided in Figures 2, 3, and 4, and map of nitrate detections from all wells is provided in Figure 5.

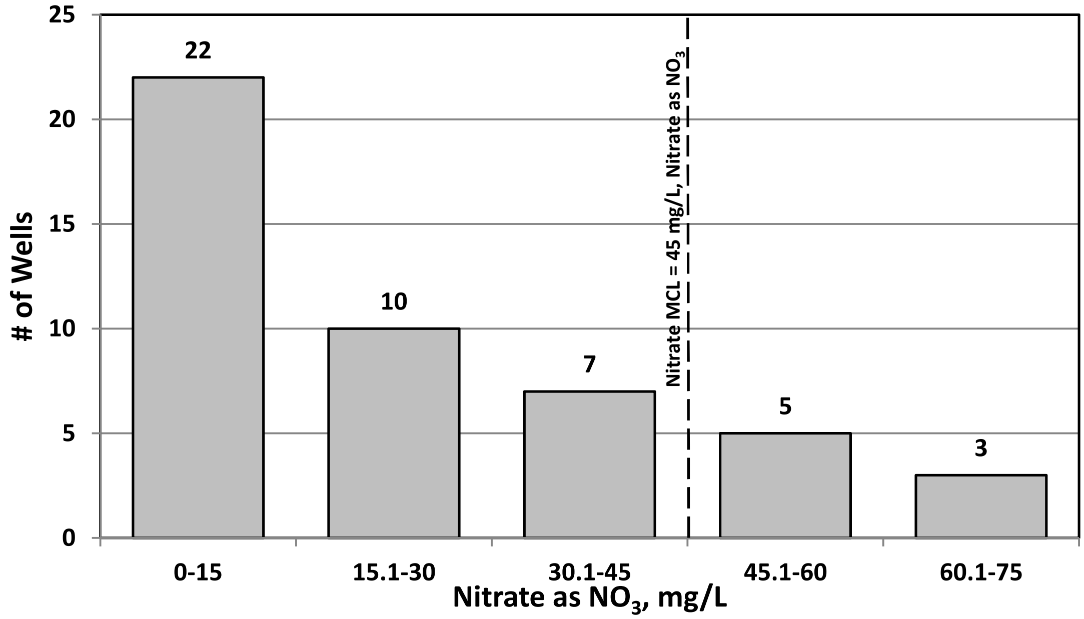


Figure 2 – Median Nitrate Concentrations in Coyote Valley Wells Tested 4 Times or More

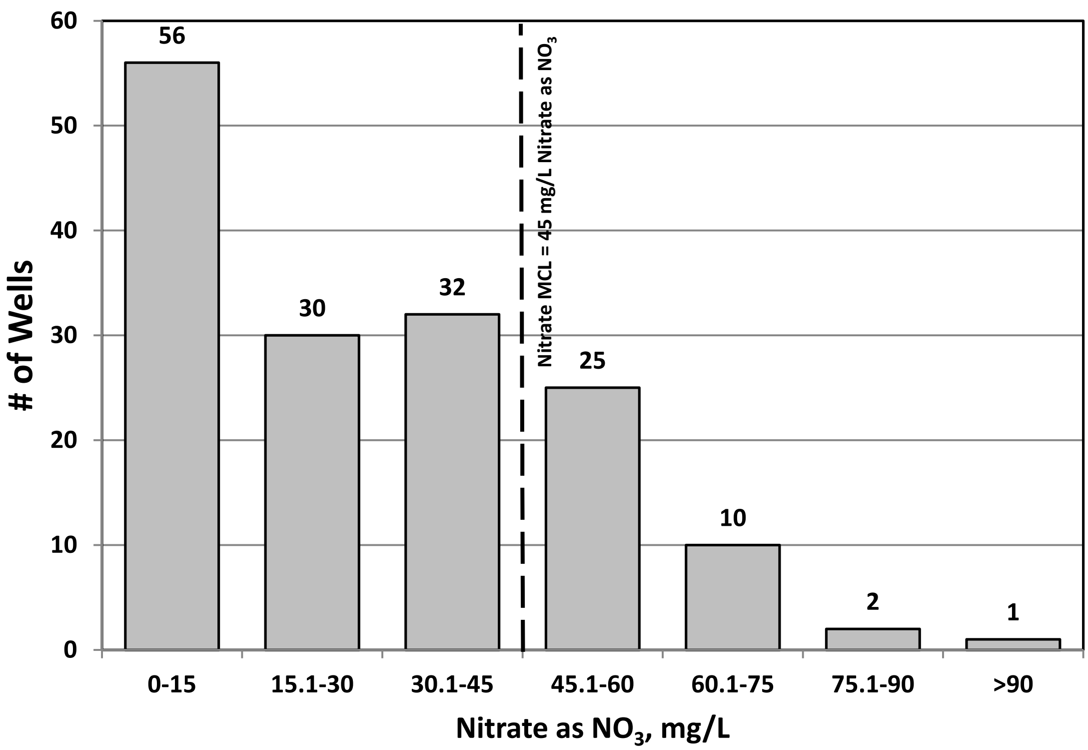
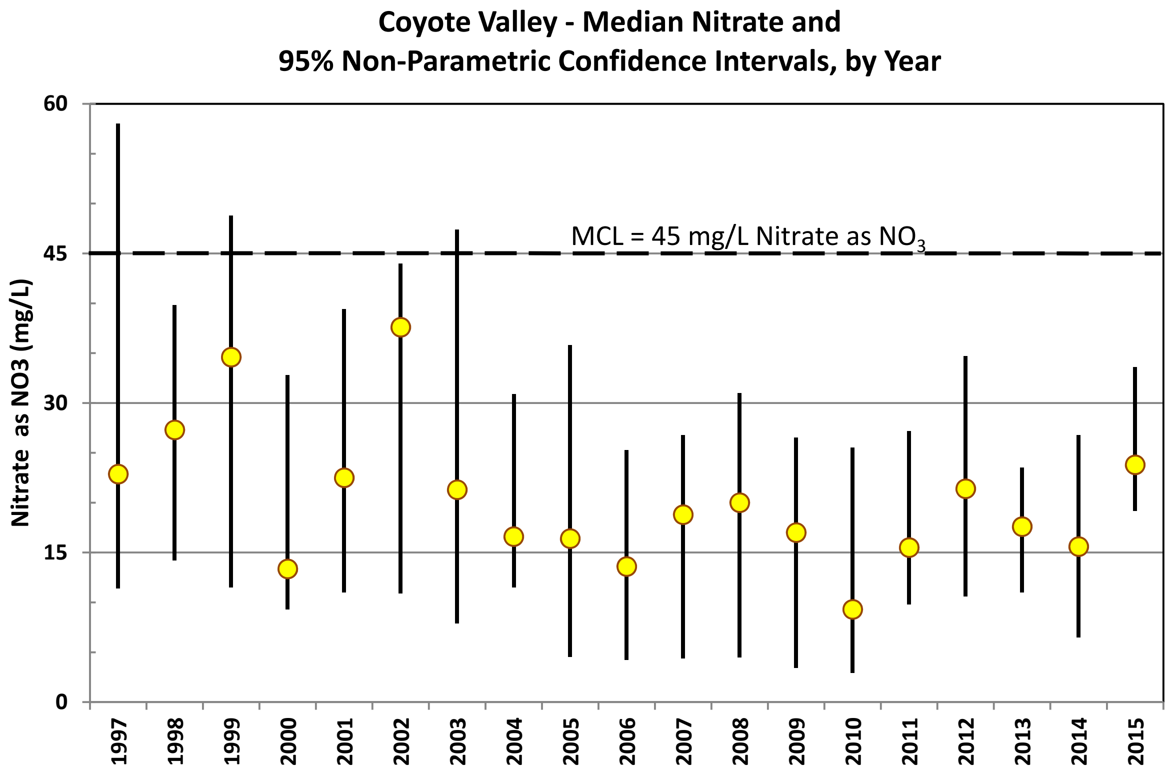
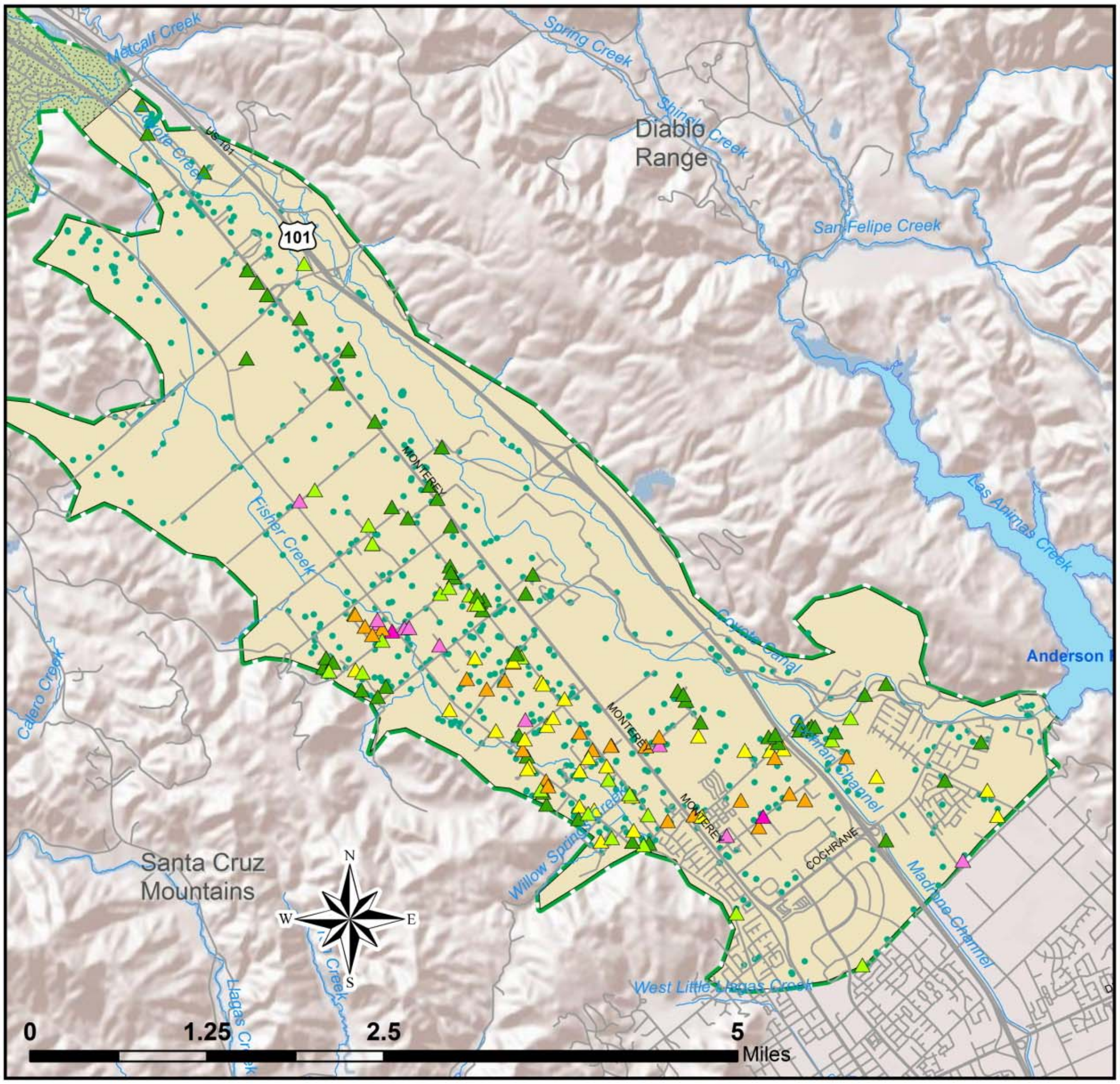


Figure 3 – Average Nitrate Concentration by Well for All Wells Tested in Coyote Valley



Note - data should not be used to interpret a trend. The number of wells sampled varies significantly by year, some wells are close to sources of recharge, and wells are screened at different depths.

Figure 4 –Median Coyote Valley Nitrate Concentration in Years with 10 or More Wells Tested



Median Nitrate as NO3, mg/L, All Years (1949 - 2015)

- ▲ 0 -15
- ▲ 15 - 30
- ▲ 30 -45
- ▲ 45 - 60
- ▲ 60 - 75
- ▲ >75

• Coyote Valley Wells - not tested

Santa Clara Subbasin (DWR Basin 2-9.02)

NOTE: Date range is from 1949 to 2015. Some wells have been tested only once and results may be decades old. This map should not be used to interpret current conditions in the Coyote Valley subarea of the Santa Clara Subbasin; it is intended to display spatial extent of past and recent nitrate results.

Figure 5 – Map of All Coyote Valley Nitrate Well Test Results

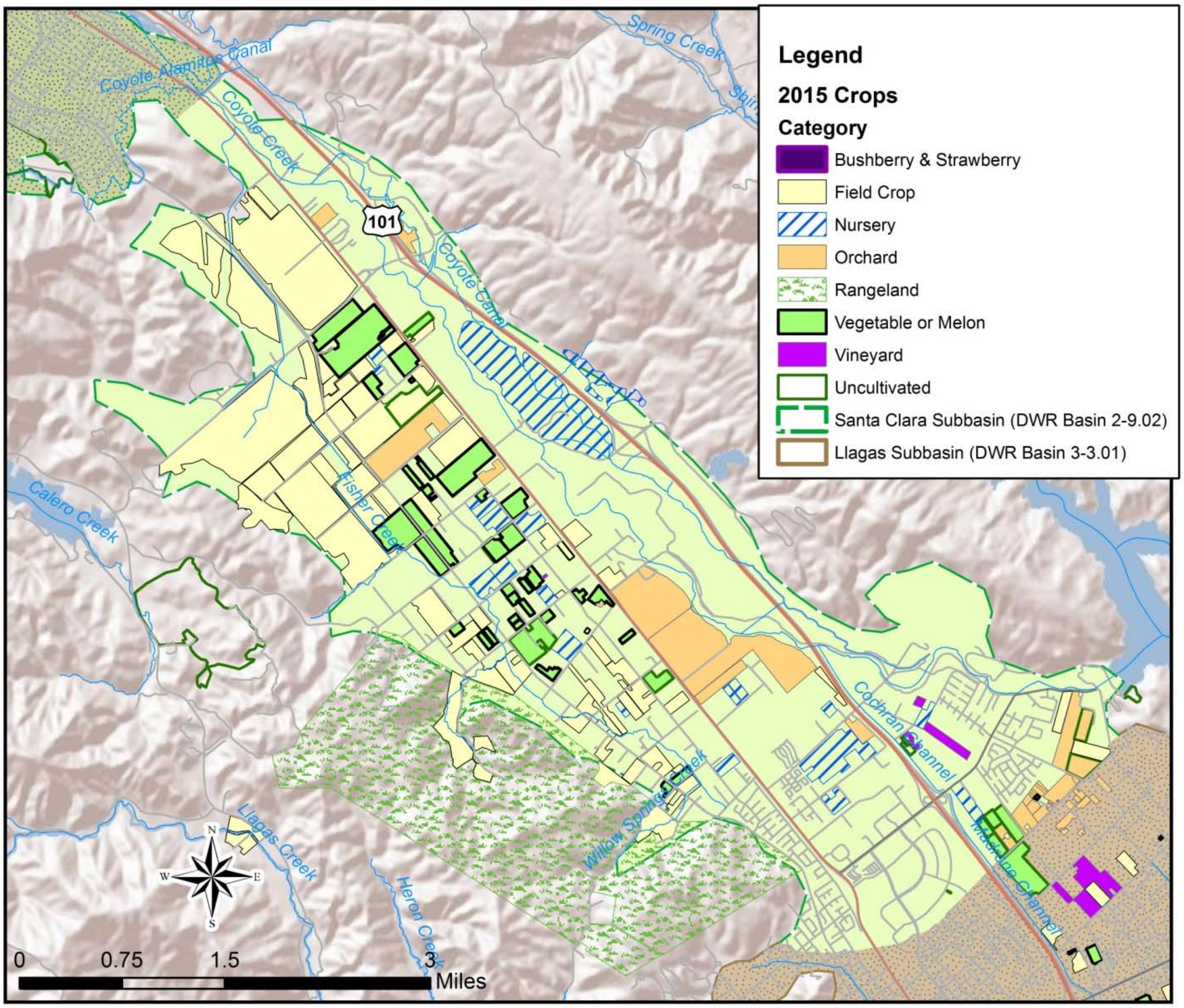


Figure 6 – 2015 Cropping Patterns in Coyote Valley
(Based on Data from the Santa Clara County Agriculture Commissioner's Office)

The SNMP discusses nitrate from fertilizer application in Section 3.3.2.1. The factors used to estimate fertilizer type and use for different crops were obtained from the University of California Cooperative Extension. Factors used and calculations of nitrogen loading are provide in Tables 1 and 2, below, using 2011 crop data obtained from the Santa Clara County Agriculture Commissioner's office.

Commodity	Nitrogen, lbs/acre/yr	lbs NO3/acre /yr, leached	Commodity	Nitrogen, lbs/acre/yr	lbs NO3/acre /yr, leached
ALFALFA	115	178.3	LETTUCE HEAD	190	294.6
ALMOND	200	310.1	LETTUCE LEAF	190	294.6
AMARANTH, EDIBL	75	116.3	LETTUCE ROMAINE	220	341.1
APPLE	21	32.6	MELON	137	212.4
APRICOT	40	62.0	MINT	200	310.1
ARRUGULA	125	193.8	MIZUNA	190	294.6
ARTICHOKE	200	310.1	NAPA CBG TGHT H	180	279.1
ARTICHOKE SEED	200	310.1	NECTARINE	150	232.6
BARLEY	65	100.8	N-GRNHS FLOWER	0	0.0
BASIL	100	155.1	N-GRNHS PLANT	0	0.0
BEAN DRIED	96	148.8	N-OUTDR FLOWERS	0	0.0
BEAN DRIED SEED	96	148.8	N-OUTDR PLANTS	0	0.0
BEAN SPROUT	0	0.0	N-OUTDR TRANSPL	0	0.0
BEAN SUC SEED	96	148.8	OAT	150	232.6
BEAN SUCCULENT	165	255.8	OF-FLWRNG PLANT	0	0.0
BEAN UNSPECIFD	130	201.6	OLIVE	135	209.3
BEET	165	255.8	ONION DRY ETC	180	279.1
BLACKBERRY	60	93.0	OP-FLWRNG PLANT	0	0.0
BOK CHOY LSE LF	175	271.3	OP-FOLIAGE PLNT	0	0.0
BROCCOLI	220	341.1	OP-TURF	100	155.1
BROCCOLI SEED	220	341.1	ORANGE	110	170.6
CABBAGE	180	279.1	OT-PALM	0	0.0
CAULIFLOWER	240	372.1	PASTURELAND	42	65.1
CAULIFLOWR SEED	240	372.1	PEACH	150	232.6
CELERY	200	310.1	PEAR	150	232.6
CHERRY	60	93.0	PEPPER FRUITNG	388	601.6
CHRISTMAS TREE	92	142.6	PEPPERMINT	200	310.1
CHRYSAN GARLAND	0	0.0	PERSIMMON	108	167.5
CILANTRO	148	229.5	PLUM	125	193.8
CORN, FIELD	240	372.1	PRUNE	150	232.6
CORN, HUMAN CON	210	325.6	PUMPKIN	137	212.4
CUCUMBER	190	294.6	RADICCHIO	125	193.8
CUCUMBER SEED	190	294.6	RANGELAND	0	0.0
FORAGE HAY/SLGE	80	124.0	RAPE	175	271.3
FRISEE	180	279.1	RASPBERRY	60	93.0
GAI CHOY LSE LF	180	279.1	RESEARCH COMMOD	0	0.0
GAI LON TGHT HD	180	279.1	SPINACH	60	93.0
GARLIC	200	310.1	SQUASH	317	491.5
GF-CARNATION	0	0.0	STRAWBERRY	150	232.6
GF-CHRYSANTHMUM	0	0.0	SUNFLOWER	95	147.3
GF-FLOWER SEED	0	0.0	SWISS CHARD	180	279.1
GF-FLWRNG PLANT	0	0.0	TOMATO	164	254.3
GF-FOLIAGE PLNT	0	0.0	TOMATO PROCESS	182	282.2
GRAPE	20	31.0	VEGETABLE	104	161.3
GRAPE, WINE	20	31.0	WALNUT	200	310.1
GT-FLWRNG PLANT	0	0.0	WATERCRESS	50	77.5
KALE	180	279.1	WHEAT	100	155.1
KIWI	161	249.6	WHEAT FOR/FOD	100	155.1

Table 1 – University of California Cooperative Extension Crop Factors for Nitrogen Loading. Note: These factors were used to calculate fertilizer loading in Table 3-15 in the SNMP.

	UCCE Crop Factors		Coyote Valley			Santa Clara Plain			Santa Clara Subbasin Total	
Commodity	**Nitrogen, lbs/ acre/ year**	**Nitrate as NO_3 lbs /acre/year , leached**	**Acres**	**Nitrate as NO3 Loading, lbs/yr**	**Salt as TDS Loading, lbs/yr**	**Acres**	**Nitrate as NO3 Loading, lbs/yr**	**Salt as TDS Loading, lbs/yr**	**Nitrate as NO3 Loading, lbs/yr**	**Salt as TDS Loading, lbs/yr**
Alfalfa	115	178	313.3	55,869	36,033				55,870	36,030
Amaranth, Edible	75	116	4.5	525	338				520	340
Apple	21	33	10.5	343	222	2	50	32	390	250
Apricot	40	62	35.9	2,226	1,436	78	4,839	3,121	7,070	4,560
Basil	100	155	2.3	356	229				360	230
Bean Succulent	165	256				1	383	247	380	250
Bean Unspecified	130	202	3.0	602	389				600	390
Bok Choy	175	271	14.1	3,828	2,469				3,830	2,470
Cherry	60	93	378.8	35,243	22,730	11	988	637	36,230	23,370
Corn, retail	210	326	81.9	26,670	17,201	16	5,364	3,459	32,030	20,660
Forage Hay/Silage	80	124				131	16,287	10,504	16,290	10,500
Grape	20	31				0	10	7	10	7
Grape, Wine	20	31	6.5	202	130	56	1,732	1,117	1,930	1,250
Kiwi	161	250	3.7	935	603				930	600
Oat	150	233	121.1	28,172	18,169	240	55,884	36,043	84,060	54,210
Olive	135	209				150	31,484	20,306	31,480	20,310
Op-Turf	100	155	15.7	2,438	1,573				2,440	1,570
Orange	110	171				15	2,528	1,631	2,528	1,631
Pastureland	42	65				150	9,753	6,290	9,753	6,290
Peach	150	233				1	153	99	150	100
Peppers, Fruiting	388	602	71.5	43,024	27,749	2	1,204	776	44,230	28,520
Prune	150	233				3	589	380	590	380
Squash	317	492				1	490	316	490	320
Tomato	164	254				2	509	328	510	330
Walnut	200	310				1	254	164	250	160
Wheat	100	155	172.7	26,782	17,273	136	21,025	13,560	47,810	30,830
Wheat (Fodder)	100	155	37.3	5,784	3,731	11	1,748	1,127	7,530	4,860
TOTAL, tons per year			**1,273**	**116**	**75**	**1,007**	**78**	**50**	**194**	**125**

Table 2 – Calculated Salt and Nitrate Loading from Fertilizer Sources in the Santa Clara Subbasin, Based on 2011 Cropping Patterns (used to calculate values presented in SNMP Table 3-15)

June 1, 2016

Ms. Vanessa de la Piedra
Groundwater Monitoring and Analysis Unit Manager
Santa Clara Valley Water District
5750 Almaden Expressway
San Jose, CA 95118

Sent via Email to vdelapiedra@valleywater.org

SUBJECT: Concurrence with the Salt and Nutrient Management Plan for the Santa Clara Subbasin, Santa Clara County

Dear Ms. de la Piedra:

Thank you for the opportunity to review the Water District's 2014 Salt and Nutrient Management Plan for the Santa Clara Subbasin (SNMP). We're pleased to concur with the SNMP as it provides a solid foundation for guiding decision making and promotes recycled water use in the Santa Clara Valley.

As a result of this process, we've come to better understand groundwater conditions in the Santa Clara and Coyote Valleys, and the challenges the District faces related to the quality and reliability of imported surface water that is used for groundwater recharge. We applaud the innovative solution to use advanced purified water to help manage salt and nutrient contributions to the basin and achieve the District's 10% recycled water goal. We also recognize the District's efforts to address elevated nitrate conditions in the Coyote Valley and provide outreach and solutions to private well owners.

We would like to acknowledge the professionalism and hard work of District staff to address our feedback on earlier SNMP versions. As a result, we are confident that the SNMP will effectively manage salts and nutrients from all sources, and will attain water quality objectives and protect beneficial uses of groundwater. As such, the SNMP meets the requirements of the State Water Resources Control Board's 2009 "Policy for Water Quality Control for Recycled Water".

Water Board staff will continue working cooperatively with District staff to implement the recommendations presented in the SNMP. In particular, we will collaborate with District staff to better understand the nature of elevated nitrate concentrations in groundwater within the Coyote Valley, and how sources can most effectively be addressed to protect domestic use of groundwater.

In the next few months we anticipate bringing a resolution of support for the District's SNMP to our Board and will coordinate with District staff as appropriate.

If you have any questions, please contact Alec Naugle of my staff at (510) 622-2510 or via email at alec.naugle@waterboards.ca.gov.

Sincerely,

Dyan Whyte
Assistant Executive Officer

Cc: Tom Mohr (tmohr@valleywater.org)

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